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Assessing a quantitative approach to tactical asset allocation

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Abstract

Against a backdrop of controversy surrounding market timing, this research assesses the merits of a tactical asset allocation strategy for the South African market. The purpose of this research is to assess whether a simple quantitative method - initially presented by Faber (2007) - can successfully reduce volatility and increase returns of selected indices within the Johannesburg Stock Exchange (JSE). The All Share (ALSI), Financial & Industrial (FINI), Resource (RESI), Africa Gold Mining (AGMI), Government Bond (GOVI) and Property Unit Trust (PUTI) indices were examined. A strategy based on a ten-month simple moving average was compared against a buy-and-hold strategy, with results presented for these strategies both excluding and including transaction costs. The strategies were tested over a 50-year period from 1961 to 2010. The results show that superior risk-adjusted returns are possible even in the presence of high transaction costs. Further insights suggest that tactical asset allocation strategies yield improved performances when used in specific sectors and/or asset classes, instead of in consolidated sectors represented by the market.

Keywords:

Tactical Asset Allocation, Market Timing, Active Management and Quantitative

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Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Signature

1 August 2011
Date

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1 Introduction to Research Problem

The aim of this research is to assess a quantitative approach to tactical asset allocation to reduce volatility and increase the investment returns available from selected Johannesburg Stock Exchange (JSE) indices.

Asset allocation is fundamental in determining investment results and is central to any investment process. Despite its importance, empirical evidence shows that investors get asset allocation wrong more often than they get it right.

The reason for this is that the asset allocation decision-making process is often overwhelmed by psychological factors and forces such as anchoring, myopia and herding. This means that investors allow subjective forces such as gut feel, hunches and partial information to guide the single most important decision in investing, asset allocation. This result is not specific to any part of the world. It is a phenomenon that is observable globally and South African evidence follows this result.

Recent research, including results produced by Faber (2007), has demonstrated that vulnerabilities in decision making, caused by psychological influences can be overcome or at least moderated by using a simple quantitative tactical asset allocation rule. Using this rule the investment process produces results that start to approximate the theoretical attraction of asset allocation and that are different to the week practical evidence that exists. Whilst this asset allocation tool has been shown to be effective in other markets it has not been tested in the South African environment.

Against this backdrop, the aim of this research is to assess whether this rule can successfully reduce volatility and increase returns of selected indices within the JSE.

1.1 Background

Throughout human history people have traded amongst themselves, bartering and haggling for what they thought was a fair trade. In modern times the stock exchange has become home to an important centre of trade, namely exchange in company ownership. In this setting, brokers buy and sell stocks on behalf of their clients, with the never-ending quest to get the best deal, be the best and hence beat the market. The secret to beating the market has become a life's quest for any serious analyst, with a multitude of theories and hypotheses being tried and tested to achieve gains greater than that of the market average. The truth however, is that very few investors have been able to consistently beat the market and those who have, have remained quiet on the exact formula they have used to achieve their results. The question as to whether it is possible to predict how stocks on the exchange will behave over a period of time is one that is hotly contested within academic circles, with arguments both for and against the ability to successfully time the market.

Theories such as "the random walk hypothesis" and "efficient-market hypothesis" advocate against the predication of future movements within the stock exchange. The concept that movements within the stock exchange are completely random can be dated back to a French economist Jules Regnault who published the book "*Calcul des Chances et Philosophie de la Bourse"* in 1863. However, it was only in the early 1970s that "*A Random Walk down Wall*

Street" (B. G. Malkiel, 1973) popularised the term. The efficient-market hypothesis supports the notion of unpredictability but from a different angle. The hypothesis has three major versions, namely a "weak", a "semi-strong" and a "strong" version. In essence the theory states in various degrees that markets are information-efficient systems and that all available information is known to the investor at the time of trade. Thus stocks cannot be under- or overvalued for protracted periods, meaning that stock markets are rational and efficient in their pricing.

Notwithstanding these arguments, the efficient market hypothesis validity has come under criticism from various sources. A recent example of this is the case of people who blame the belief in rational markets for the financial crisis of 2007 to 2010 (Fox, 2009; Nocera, 2009). More importantly, if markets are inefficient, meaning assets become mispriced, investors are presented with an opportunity to produce extraordinary gains by capturing the inefficiency. The act of market timing exemplifies the belief in inefficient markets. Market timing is the act of attempting to predict the future direction of the market, typically through the use of technical indicators or economic data. There are two aspects to market timing - that of technical indicators (objective data) and economic data (subjective data).

1.2 The Research Problem

The focus of this study will be the use of technical indicators to assist with market timing. Using market timing as an investment is a controversial practice. As mentioned in the background to this research, there are those who outright dispute the predictability of future stock price movements. However, the supporters of market timing can be dated back to Charles Dow, the creator of the Dow Jones Industrial Average. Charles Dow proposed a wave theory, cycles in which the market moves up and down (Siegel, 2008). He postulated that there was a primary wave that determined the overall trend of the market, on which secondary and tertiary waves could be superimposed. His claim was that an investor could determine which trend the market was in, by analysing a chart of the Dow Jones Industrial Average. Pring (1991) argued that had investors implemented Dow's strategy they could have avoided the devastating losses of the 1929 stock market crash.

In this vein, in "*A Quantitative Approach to Tactical Asset Allocation*", Faber (2007) analysed the results of a market-timing strategy. The strategy utilising a ten-month simple moving average of index prices was used to build a portfolio whose performance was then compared to a buy-and-hold strategy over the same period. The strategies were implemented on selected indices over a 30-year period within the United States. The indices included the Standard and Poor's 500 Index (S&P 500), the Morgan Stanley Capital International Developed Markets Index (MSCI EAFE), the Goldman Sachs Commodity Index (GSCI), the National Association of Real Estate Investment Trusts Index (NAREIT), and the United States Government Ten-Year Treasury Bonds. Faber was able to show that a simple timing strategy was able to outperform a buy-and-hold strategy on the selected indices implemented from 1972 to 2006. Outperforming meant the strategy was able improve return and reduce volatility of the investment. Investors would be able achieve greater returns, while limiting their exposure to fluctuations within the market.

This research is a replication study of Faber's approach to tactical asset allocation on selected JSE indices in South Africa. Jeremy Siegel points out that a major flaw in tactical asset allocation strategies, is the transaction costs that are incurred from moving in and out of the market multiple times. He states that high transaction costs and or excessive switching can erode any gains in performance the strategy may yield, when compared to a buy-and-hold strategy (Siegel, 2008). In Faber's original paper, he did not include these transaction costs. However, this research will include the transaction costs relevant to the JSE. This represents an important extension to Faber's original research.

1.3 Objective of this Research

The aim of this research is to test a market-timing strategy on selected Indices within the JSE over a 50-year period, and to compare results to a buy-and-hold strategy over the same period. The research aimed to explore five main questions. First, does the timing strategy significantly reduce volatility on investment? Second, does the timing strategy improve return, excluding transaction costs? Third, does the timing strategy improve return, including transaction costs? Forth, does the timing strategy yield the optimum solution or do other timing strategies perform better. Finally, the research aims to compare the performance between indices in order to determine whether the timing strategy yields better results for particular asset classes.

2 Literature Review

The aim of this literature review is to build an argument that provides reasons for assessing a quantitative approach to tactical asset allocation. The following line of reasoning has been employed: First, has asset allocation been an important factor in increasing the performance of stocks and portfolios? Second, if asset allocation has been important, what does the literature tells us about how successful investors have been in the past? Third, what were the factors that influenced investors' past performance?

In order to build an argument as to the importance of asset allocation it is critical to establish the terminology that has been used throughout this report. Multiple papers used different terminology when discussing asset allocation, in this report asset allocation has been split into two variants - namely tactical asset allocation and passive asset allocation.

Passive asset allocation has been referred to as "investment policy" (Brinson, Hood, & Beebower, 1986) or "asset allocation policy" (Hensel, Ezra, & Ilkiw, 1991; Ibbotson & Kaplan, 2000; Xiong, Ibbotson, Idzorek, & Chen, 2010). Passive asset allocation has been defined as "The decision of how a fund should be invested across each of several asset classes, assuming neutral capital market conditions exist. This condition implies that asset class return expectations are roughly proportional to the asset classes' assessed riskiness; no class is considered to be under-priced or overpriced" (Hensel *et al.*, 1991).

Tactical asset allocation (Dichtl & Drobetz, 2009; Faber, 2007; Weigel, 1991) has been referred to as "market timing" (Brinson *et al.*, 1986; Firer, Ward, & Teeuwisse, 1987), "active return" (Ibbotson & Kaplan, 2000; Ibbotson, 2010) and "active management" (Hensel *et al.*, 1991; Xiong *et al.*, 2010). Tactical asset allocation broadly refers to active strategies that seek to enhance performance, by opportunistically shifting the asset mix of a portfolio in response to changing patterns of reward available in the capital markets (Arnott & Fabozzi, 1988).

2.1 The Importance of Asset Allocation

Asset allocation is central to investment results. This point was brought to attention as early as the mid-1980s by Brinson, Hood & Beebower (1986). They tried to determine a method of separating the performance contribution of those activities that compose the investment management process, namely investment policy, market timing and security selection. Brinson *et al* (1986) showed that 90% of the variation in returns is explained by passive asset allocation. Interestingly this paper has been widely misquoted and highly criticised for floored methodology. Ibbotson (2010) explains that "Unfortunately, their time-series results were not very sensitive to each fund's asset allocation policy because most of the high variation came from aggregate market movement". Notwithstanding this fact it remains the case that asset allocation is pivotal, which was later shown by a flurry of other papers (Hensel *et al.*, 1991; Ibbotson & Kaplan, 2000; Xiong *et al.*, 2010).

The reason for the high correlation in passive asset allocation was that Brinson *et al* used cash as a baseline instead of a market neutral hedge fund (Ibbotson, 2010). "*The Importance of the Asset Allocation Decision*" (Hensel *et al.,* 1991) stated that different decisions - including tactical asset allocation and passive asset allocation - affected the return on an investment. The paper found that each decision could be measured by comparing a portfolio's actual return with the return on a hypothetical portfolio that does not reflect a particular decision that went into the real portfolio. They referred to this hypothetical portfolio as the naïve alternative. If the naïve alternative was generated using treasury bills, then the belief that 90% of returns could be attributed to passive asset allocation was correct. However, if the naïve alternative was generated using a diversified mix of stocks (e.g. average asset mix across pension funds), then other decisions (tactical asset allocation) had significantly more weighting than had previously been attributed to them. (Hensel *et al*., 1991)

Throughout the last twenty years, new values have been attributed to asset allocation. Ibbotson and Kaplan (2000) presented a cross-sectional regression on annualised cumulative returns across a large universe of balanced funds over a ten-year period, finding that about 40% of the variation in returns across funds was explained by passive asset allocation. Vardharaj and Fabozzi (2007) applied similar techniques to Ibbotson and Kaplan by using equity funds and found that the correlations were time-period sensitive and that approximately 33% to 75% of the variance in fund returns across funds were attributable to differences in asset allocation policy.

Xiong *et al.* (2010) is the latest work on this topic. The paper divided investment return into three components: (1) the applicable market return; (2) passive asset allocation returns in excess of market return; and (3) the excess return from active asset allocation. The fundamental issue with research on this topic to date has been the presences of a market return within the calculated results. Xiong *et al* (2010) made a fundamental yet simple observation that cross-sectional regressions naturally removed market movements. By combining cross-sectional analysis with time-series analysis, they were able to remove the presence of market returns. Under these conditions they found that passive and active asset allocations are equally important.

In summary asset allocation is fundamental to influencing the performance of an investment. Both tactical asset allocation and passive asset allocation are equally important, and play a significant role in wealth creation.

2.2 The Performance of Investors in Asset Allocation

With the importance of asset allocation established, it is now important to understand how investors have performed at asset allocation both passively and tactically. Hirschey and Nofsinger (2010), in an excerpt from their book sets about describing the skills an investor required to generate returns in excess of the market. They described the skills as both tactical and analytical, highlighting the importance of tactical and passive asset allocation. In their conclusion they stated, “in practice, few portfolio managers display the superior tactical and analytical skills necessary to outperform the market on a long-term basis” (Hirschey & Nofsinger, 2010).

The evidence to support this statement goes as far back as the late 1960s. Jensen (1968) set about trying to establish the ability of investors to increase returns on their portfolios. He looked at their ability to successfully predict future security prices, as well as their ability to minimise the amount of "insurable risk" born by the holders of those portfolios. He investigated 115 mutual funds in the US over the period 1955 to 1964 and found that the mutual funds were on average not able to predict security prices well enough to outperform a buy-and-hold policy. He also found that there was little evidence to show that an individual fund was able to do significantly better than that which was to be expected from pure random chance.

During the 70s and 80s a series of other papers reached similar conclusions, evaluating the performance of actively managed unit trusts in the United States over those periods (Chang & Lewellen, 1984; Hendricksson, 1984; Kon & Jen, 1979; McDonald, 1974).

Lakonishok, Shleifer, Vishny, Hart and Perry (1992) provided evidence on the structure and performance pension funds in the United States. They examined 769 pension funds and found the equity performance of the funds underperformed the S&P 500 by 1.3% per year, throughout the 1980s.

Malkiel (1995) took a new look at mutual fund returns on the New York stock exchange during the period 1971 to 1991. He utilised data sets that included the returns from all mutual funds in existence, in each year of the period. When returns from all these funds were analysed, he found that they had tended to underperform in the market - not only after management expenses had been deducted, but also gross of all reported expenses except load fees. Malkiel (2003) expanded his work to include all mutual funds on the New York stock exchange from 1970 to 2001. He commented that “Of the original 355 funds, only five of them outperformed the market by two percent per year or more”.

Dreman (1998) presented results from the Vanguard Group, which measured the performance of active managers over each decade since the 1960s. The results showed that 90% of managers underperformed the market.

Blake and Timmermann (1998) examined the returns (gross of fees) on 2300 United Kingdom open-ended mutual funds, over the period 1972 to 1995. They found economically and statistically a very significant underperformance of mutual funds over the period.

"A remarkably large body of evidence suggests that professional investment managers are not able to outperform index funds that buy and hold the broad stock market portfolio" (B. G. Malkiel, 2003).

Not all the evidence points to the same conclusion. Chen and Stockum (1986) investigated 43 unit trusts within the United States and found that 13 funds had significant and positive selectivity. Grinblatt and Titman (1989) analysed a large sample of United States unit trusts over the period 1974 to 1984. The authors found evidence that supported the hypothesis that superior investment talent existed within the group of funds analysed. Malkiel (2003) himself commented that throughout the 1990s, about three-quarters of actively managed funds failed to beat the index, thereby implying that one-quarter did manage to beat the index.

Despite this, "On balance the international evidence leans heavily in favour of the conclusion that, collectively, active managers are unable to consistently beat the market" (Saville, 2008)

The evidence for the South African market is slim. However, the majority of studies fall in line with international evidence. Knight and Firer (1989) showed that there was little evidence that South African unit trust fund managers exhibited superior selection and timing skills. Similar observations were made in other papers (Akinjolire & Smit, 2003; Chapman & Smith, 1993; Oldfield & Page, 1996).

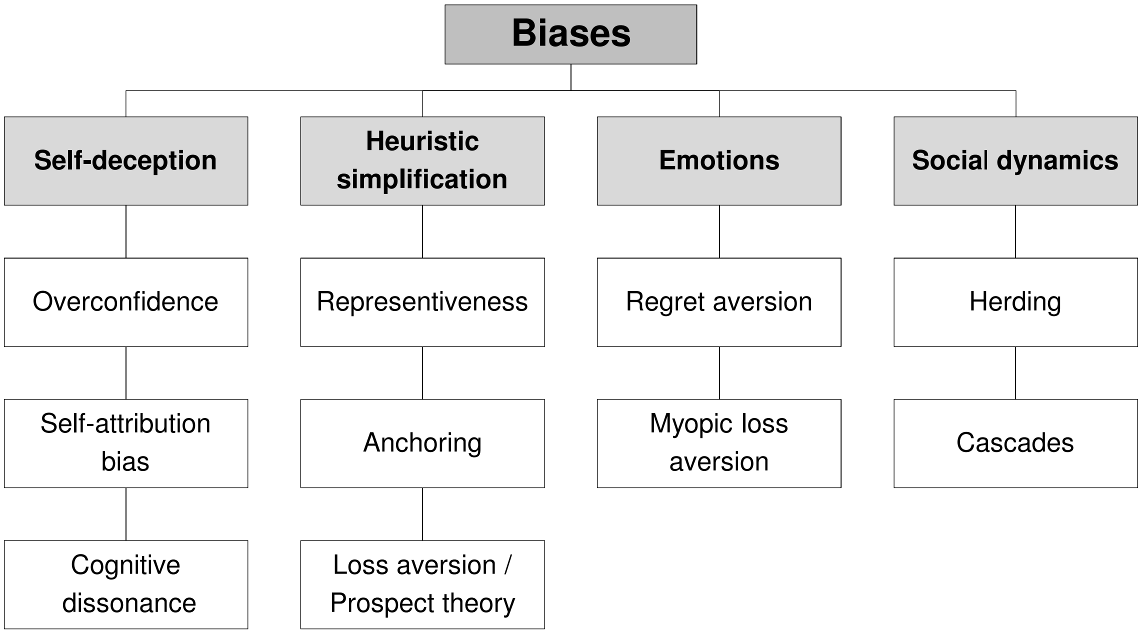
2.3 Factors That Have Influenced Investors' Past Performance

Morrin *et al.* (2002) compare the performance of a group of analysts. The study revealed that the way analysts perceive data varied significantly and did not reveal any systematic patterns. This meant all individuals would not interpret data in the same way. More importantly, the same individuals may not interpret data in the same way the next time round, and hence investing decisions became inconsistent.

Despite the importance of asset allocation, empirical evidence showed that investors get asset allocation wrong more often than they get it right (Hirschey & Nofsinger, 2010). The reason is that the asset allocation decision-making process was often overwhelmed by psychological factors and forces. The realisation of the existence of these factors and forces led to a whole new area of economic study, called behavioural finance.

In the late 1970s two psychologists, Amos Tversky and Daniel Kahneman developed a model of how individuals actually behaved and made decisions when faced with uncertainty (Siegel, 2008). Kahneman and Tversky's (1979) work on prospect theory established these two psychologists as the pioneers of behavioural finance. Prospect theory covered psychological factors such as loss aversion, mental accounting and anchoring. Behavioural finance, in its present form, covers even more factors such as herding instinct, information cascade, self-attribution bias, representative bias, myopic loss aversion and cognitive dissonance. These factors will be discussed and reviewed in more detail. Multiple papers have been written on each of these factors but despite the available literature, most investors are either ignorant or unable to overcome their human nature. Siegel (2008) pointed out that "for many people being successful in investing requires a much deeper knowledge of themselves". The old Wall Street adage stated that "The stock market is a very expensive place to find out who you are" (Siegel, 2008).

Figure 2.1 A Taxonomy of Investor Biases



Hirschleifer (2001) suggested that most investment mistakes could be traced to four common causes: self-deception, heuristic simplification, emotion and social dynamics. Figure 2.1 represents a summary model of Hirschleifer's (2001) work on investment psychology and asset pricing. The model arranges the major biases in line with these causes. Only those biases with direct implications for investment were included. The model was used as a framework for discussion in the proceeding sections.

2.3.1 Self-Deception

Montier (2007) stated that self-deception biases limit our ability to learn. The self-attribution bias causes an individual to take credit for favourable returns when credit is not due. When people suffer from this bias they do not learn from their mistakes, simply because they do not realise they have made any. Self-attribution can lead to overconfidence.

Overconfidence in investment decisions can cause an investor, to trade beyond his or her means and/or abilities (Siegel, 2008). Siegel claimed that "Most investors believe they are better than the average, which of course is statistically impossible".

Overconfidence also stems from an illusion of control and an illusion of knowledge (Montier, 2007). The illusion of knowledge is the tendency for people to believe that the more information they have, the more accurate their forecasts will be. The illusion of control is people's beliefs that they have influence over the outcome of uncontrollable events. Montier (2007) concluded by saying that "The more information you have, the more in control you will tend to feel".

Self-deception is also routed in cognitive dissonance (Hirshleifer, 2001). Cognitive dissonance is people's ability to disregard information that conflicts with their own views (Siegel, 2008). Cognitive dissonance is associated with the discomfort people feel when confronted with information that suggests people's abilities and actions are not as good as they thought they were. Siegel stated that people have a natural tendency to minimise their discomfort, which makes it difficult for people to recognise their overconfidence.

2.3.2 Heuristic Simplification

Hirschey and Nofsinger (2010) explained heuristic simplification as the brains ability to reduce the complexity of analysing information by using shortcuts. Heuristic simplification is linked to information-processing errors (Montier, 2007).

Representative bias has its premise in human learning. When people are presented with something new that seems familiar, they form a representative heuristic to help them learn. Investors can draw parallels between events that seem the same; this has led to “some specular wrong moves” within the stock market (Montier, 2007).

Anchoring (Tversky & Kahneman, 1974) is the phenomenon in which people tend to be unjustifiably influenced in their assessment of some quantity by arbitrary quantities mentioned in the statement of the problem. Investors often make mistakes when trying to value individual stocks by anchoring on past stock prices (Hirschey & Nofsinger, 2010).

Siegel (2008) described Kahneman and Tversky’s (1979) work on prospect theory. He highlighted that the key point in their theory was that people form a reference point, from which they judge their performance. The theory showed that people are more fixated on their relative losses than they are on their relative wins. This behaviour is referred to as loss aversion (Siegel, 2008).

2.3.3 Social Dynamics

Trends and social dynamics play a large role in the determination of asset prices (Shiller, 1984). Stock prices are not based just on economic values but on psychological factors that influence the market. Shiller (1981) showed that variations in economic factors did not fully account for the volatility in stock prices. He hypothesised that the extra volatility could be explained by trends and fashions, which would have a large impact on investor decisions. The tendency of individuals to adapt their thinking to the prevailing trend is called herding instinct. The willingness to align oneself with common consensus and follow the trend or fashion of the day, has led to the overvaluing of various asset classes (Siegel, 2008). The reason people are susceptible to herding instinct can be explained by a decision-making process called information cascade. Shiller (1995) described information cascade as a phenomenon where individuals make decisions based on common consensus, because they feel “someone knows something” and they shouldn’t miss out.

2.4 Summary

By reviewing the literature, this research has shown that asset allocation forms an important part of improving the performance of an investment. Historically investors have been inconsistent and generally poor at asset allocation, and the reason for their poor performances has been due to human bias. The literature provides motivation to assess a quantitative approach to tactical asset allocation.

“To be a successful long-term investor, you must set up rules and incentives to keep your investments on track”, (Siegel, 2008).

3 Research Hypothesis and Proposition

The hypothesis for this research was based on increased return and reduced volatility using a market timing strategy. The definition of these two measurements has been defined within Chapter 4.

Hypothesis 1: A ten-month simple moving average tactical asset allocation strategy significantly reduces volatility on selected indices compared with buy-and-hold strategy for the same period.

Hypothesis 2: A ten-month simple moving average tactical asset allocation strategy (excluding transaction costs) improves return on selected indices compared with a buy-and-hold strategy for the same period.

Hypothesis 3: A ten-month simple moving average tactical asset allocation strategy (including transaction costs) improves return on selected indices compared with a buy-and-hold strategy for the same period.

Hypothesis 4: A ten-month simple moving average tactical asset allocation strategy (both excluding and including transaction costs) yields the highest return for the All Share Index over the same period, when compared against other tactical asset allocation strategies based on different monthly periods.

The research also aims to determine whether timing strategies yield better results for different asset classes. i.e. whether some asset classes are better suited to the use of tactical asset allocation strategy.

Proposition 1: Return and volatility using the tactical asset allocation strategy may vary between indices.

4 Research Method

4.1 Research Design

A quasi-experimental research strategy as described by Welman and Kruger (2005) was used to perform a quantitative descripto-exploratory study for this research report. In order to define quasi-experimental research it was important to define experimental research in such a way that the difference between the two is clear.

Experimental research is defined as research where the unit of analysis is exposed to a manipulation (Saunders, Lewis & Thornhill, 2009). A true experiment is conducted where the researcher has optimal control over the research situation and where the researcher can assign the unit of analysis randomly to groups of design.

Quasi-experimental research differs from true experimental research in that the researcher cannot randomly assign a unit of analysis to the different groups of study. Randomisation is either impossible and/or impractical. Quasi-experimental research is often used when a researcher gains access to data over a period of time. Either a single or multiple Time Series can be analysed and is most commonly used for Financial Studies (Welman & Kruger, 2005).

This study was both descriptive and exploratory in nature. Saunders *et al* (2009) describes an exploratory study as a valuable means "to find out what is happening; to seek new insights; to ask questions and to assess phenomena in a new light". They describe the objective of descriptive research as being "to portray an accurate profile of persons, events or situations".

The goal of this study was to apply a tactical asset allocation strategy (a manipulation) to selected indices (unit of analysis) within the JSE. The study was longitudinal and focused on selected indices over a period of 50-years, from 1961 to 2010. It was for this reason that a quasi-experimental design was chosen.

A Time Series of the selected indices data was obtain from both the South African Reserve Bank and I-Net Bridge, a financial institute connected to the JSE. Two strategies were then be used to setup the experiment.

Strategy 1: Buy and Hold.

The buy-and-hold strategy was implemented by assuming the indices (or equivalent portfolios) were purchased at the beginning of 1961 and then held until the end of 2010. The buy-and-hold strategy formed the control group from which the next strategy was compared.

Strategy 2: Tactical Asset Allocation

A strategy using a simple moving average (SMA) was used to determine when too enter and exit a market. A ten-month SMA was used and the following rule was implemented:

BUY RULE: Buy when month-end price > ten-month SMA.

SELL RULE: Sell and move to cash when month-end price < ten-month SMA.

The tactical asset allocation strategy formed the manipulation that was used to compare against the control group. Results were recorded for tactical asset allocation strategies, with transaction costs both excluded and included.

4.2 Unit of Analysis

The research was performed analysing indices over a 50-year period. An index is a statistical measure of the changes in a portfolio of stocks representing a portion of the overall market. This number summarises the fluctuation of share prices on a given day. An index's primary purpose is to reflect the aggregate movement of the market it represents. Hence, a single index value would be meaningless if not compared to a previous/historical value. The research intends to determine the long-term performance of a tactical asset allocation strategy on selected indices. In reality most indices cannot be bought and sold therefore the use of an index is meant as a proxy for a portfolio of stocks within an asset class. Portfolios are used to mitigate the risk of an individual stock and instead reap an average of the benefits of a group of stocks.

Welman and Kruger (2005) define units of analysis as members or elements of a population. For this research index values were used as the unit of analysis. With the understanding of what an index is and why it was decided to use indices within this study, the question of how the core constructs of this research was measured can be answered. The core constructs within this research are that of volatility and return.

Indices are represented by a number, at some point in the past a value of either one, 100 or 1000 was assigned to represent the value of a portfolio of stocks. As the value of the portfolio of stocks has fluctuated so did the number representing the index.

The running returns were measured by the percentage in gain or losses of an index, based on an early comparison. Therefore when comparing the two investment strategies the average of the gains was used to evaluate changes in returns, while the variation in returns was used to evaluate the differences in volatility.

The benefit of using an index instead of a share price is that it is representative of an asset classes (is generalisable) and that it has greater permanence. Companies list and delist off the stock exchange on a regular bases. It would be difficult to track a particular share over a 50-year period. If a stock did remained within the exchange it would be the exception not the rule, therefore if specific stocks were selected and analysed over a 50-year period, their results would not be generalisable and hence not representative.

4.3 Population of Relevance

Saunders *et al* (2009) define a population as the complete set of cases or groups. The population at hand was all indices listed on the JSE. The population of relevance was those indices that best represent the asset or equity classes chosen to be evaluated in this research.

Table 4.1 List of Selected Indices Corresponding to Chosen Asset Classes

	Index	**Asset Class Proxy**
ALSI	All Share Index	Equities
FINI	Financial Industrial Index	Financial & Industrial based Equities
RESI	Resource Index	Resource based Equities
AGMI	Africa Gold Mining Index	Commodities
GOVI	Government Bond Index	Bonds
PUTI	Property Unit Trust Index	Real Estate
STFI	Short-term Fixed Interest Call Deposit Index	Cash

4.4 Sample Size and Sampling Method

In selecting indices for this study, a non-probabilistic sampling strategy was employed. Although the majority of the entire population of indices on the JSE was available (not including those indices that started or ended within a defined time period), judgmental/purposive sampling was employed. Indices best representing specific asset and equity classes were chosen.

Saunders *et al* (2009) described purposive sampling as a procedure in which the researcher's judgement is used to select the cases that make up the sample. They explain that "This can be done on the basis of extreme cases, heterogeneity (maximum variation), homogeneity (maximum similarity), critical cases or typical cases". The intention of using purposive sampling was to assess the differences in selected asset or equity classes, and to determine whether the asset allocation strategy was effective across all classes.

4.5 Details of Data Collection

The monthly index values were collected for each selected index across the specified time frame. This type of data is known as secondary data. Saunders *et al.* (2009) describe secondary data as data that has previously been collected for some other purpose. Indices are a specific type of secondary data known as multiple-source secondary data.

Multiple-source secondary data is described as secondary data created by combining two or more different data sets prior to the data being accessed for research (Saunders *et al.*, 2009). These data sets can be based entirely on documentary or survey data. Indices are within the public domain and their validity is of financial importance therefore their reliability and robustness has been verified.

Index data was retrieved from the following databases:

- the South African Reserve Bank, and
- I-Net Bridge.

4.6 Process of Data Analysis

The research design made use of an experiment. A control group and a manipulated group were compared, however within this research both groups comprise the same population.

Step 1: After the collection the raw data for each index, a simulation of both strategies was run over the captured Time Series. Results were annualised in order to be brought in line with the common understanding of return.

Step 2: Statistical measures were generated for each Time Series. It was assumed that the results were normally distributed.

Table 4.2 Statistical Measures

Measure	**Definition**
Mean	Arithmetic average of occurrences.
Standard Deviation	Square root of variance within occurrences.
Compound Annual Growth Rate	Geometric mean of occurrences.
Sharpe Ratio	Ratio of excess returns over standard deviation.
Ulcer Index	Root-mean-square retracement of drawdown exposure.
Maximum Drawdown	The lowest relative decrease in value with respect to previous peak values.

Step 3: Descriptive Statistics were then used to compare the relevant data sets.

a) Absolute return was analysed by comparing means;

b) Risk-adjusted return was analysed by comparing compound annual growth rates and ulcer indices;

c) Volatility was analysed by comparing variances; and

d) Risk was analysed by comparing Ulcer indices and maximum drawdowns.

Step 4: A descriptive analysis across each index was performed in order to determine whether there is any difference in the results.

Step 5: Inferential statistics were used to determine the level significance of the results. Since both groups emanate from the same population the groups were dependent. Hence, a specific statistical process had to be used for the dependent populations:

a) Hypothesis test of means was done, by using Matched Pairs t-test, and

b) Hypothesis test of variances, was done using the F statistic and completing an ANOVA test.

4.7 Limitations of the Research

The limitations of the research that was conducted can be summarised as follows:

- Research results were vulnerable to rule selection. A different number of months' moving averages would have yielded different results, which were not catered for in this research.
- Results provided a historical commentary, however their relevance is uncertain should they be extrapolated.
- Transaction costs did not contain taxation.
- Indices were a proxy for an asset class and actual asset classes may perform differently.

5 Results

In presenting the results, there are two important measurements that were shown throughout the chapter. The first being the mean of monthly percentage changes, and the second being the standard deviation of the monthly percentage changes. The mean and standard deviation represent the return and volatility of a selected strategy. In most cases they were annualised, to bring results in line with standard notation. Other commonly used financial ratios were presented in order to give a clearer picture of the performance and risk profile of a particular strategy.

As previously stated, this research was a replication study of Faber's 2007 paper. In line with his work, this report first sought to demonstrate the performance of its tactical asset allocation strategy (TAA) against a simple buy-and-hold strategy (B&H). Faber (2007) implemented a TAA utilising a buy-and-sell rule based on a ten-month simple moving average (SMA). He used the Standard and Poor's 500 Index (S&P500) from 1900 to 2005 as a representation of the United States' stock market for that period. Faber's (2007) TAA alternated its investment between a selected index and cash. Returns on cash were included.

The same TAA, utilising a ten-month simple moving average was used within this research. Investments were alternated between selected indices and cash. Returns for cash were estimated using the Short Term Fixed Interest index (STFI) which is a proxy for bank call rates. As a parallel to the South African stock market, the All Share Index (ALSI) was selected.

A comparison of a TAA against a B&H was done for the period 1961 to 2010. This period spanned 50 years of the South African stock market. In differentiating itself this research included the effects of transaction costs in order to present a more comprehensive picture of the results of its TAA. Results were presented for tactical asset allocation strategy excluding transactions costs (TAAE), and tactical asset allocation strategy including transactions costs (TAAI).

Table 5.1 Costs Associated with Buying Shares on the JSE

Description	Abbreviation	Amount
Broker Fees		0.50%
Investor Protection Levy	IPL	0.0002%
Strate Ad Valorem Levy		0.0056%
Value Added Tax	VAT	0.0708%
Securities Transfer Tax	STT	0.25%
TOTAL		0.827%

Table 5.2 Costs Associated with Selling Shares on the JSE

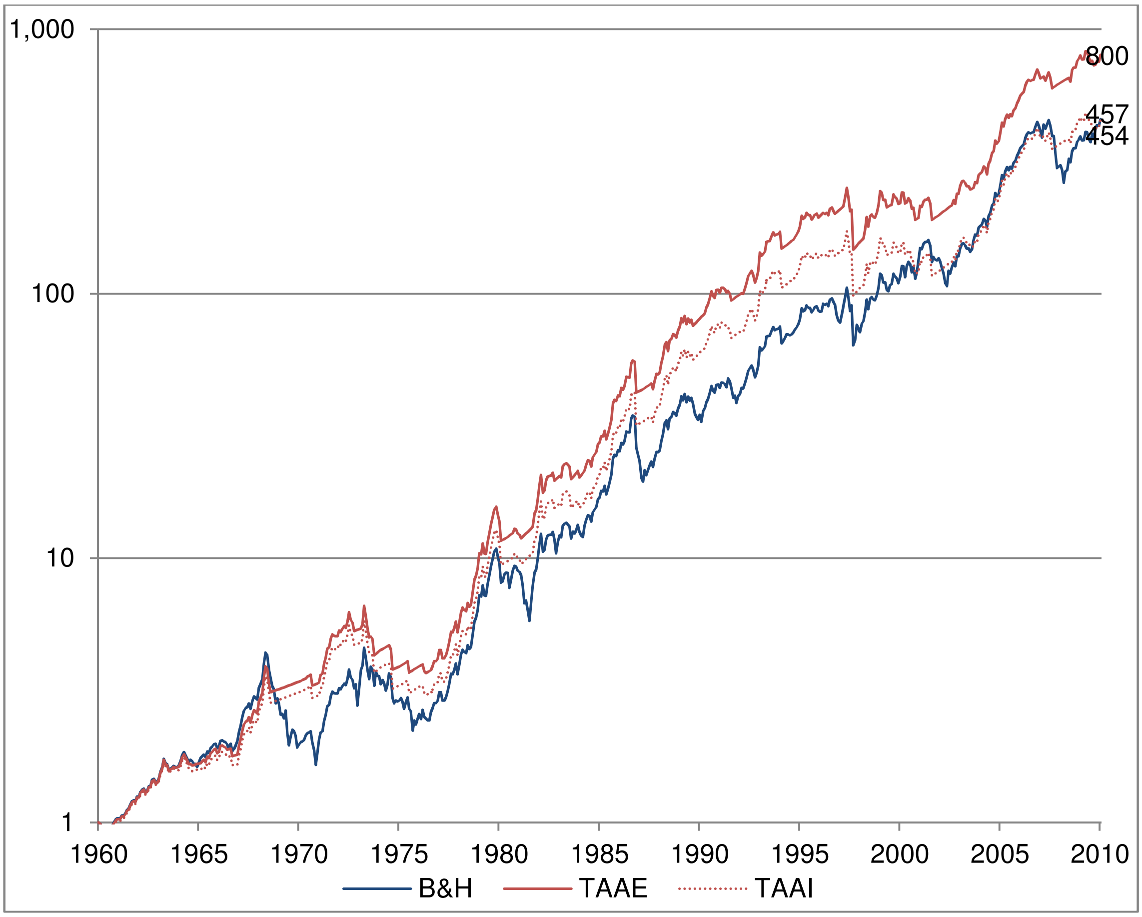
Description	Abbreviation	Amount
Broker Fees		0.50%
Investor Protection Levy	IPL	0.0002%
Strate Ad Valorem Levy		0.0056%
Value Added Tax	VAT	0.0708%
TOTAL		0.577%

The given costs were based on a portfolio held by an individual investor. It should however be noted that costs to an institutional investor would be significantly lower. Taxation was not included as this would have varied between investors and the particular asset class in which they would have been invested. For example gains in equities are subject to capital gains tax, while interest from cash is subject to income tax.

5.1 Results for All Share Index

Figure 5.1 shows investment strategies starting with an initial investment of one unit. The graph illustrates the growth of these strategies over the 50-year period. TAAE yielded the highest return at the end of the period and approximately doubled the return of B&H. However, TAAI did not show any improvement in returns over the same period.

Figure 5.1 Plot of Returns for Investments Strategies using ALSI



From the graph it can be seen that the TAAE and the TAAI yielded higher returns than B&H for the period between 1969 and 1998. The gap in returns continued expanding during this period. After the Asian crisis in 1998, TAA returns fell below the B&H. This lasted until 2002, and thereafter the TAA showed improved returns.

Table 5.3 Comparison of Strategies for ALSI from 1961 to 2010

	B&H	TAAE	TAAI
Annualised Mean	14.6%	14.9%	13.8%
CAGR	13.0%	14.3%	13.0%
Sharpe	0.22	0.29	0.22
Standard Deviation	21.3%	16.6%	16.9%
Ulcer Index	20.0%	14.7%	16.4%
Max Draw Down	62.3%	44.2%	47.7%
Time In Market	100%	70%	
Trades/Year		0.8	

In Table 5.3 the annualised monthly mean for B&H was compared with the TAAE. There appeared to be little difference between their returns, at 14.6% and 14.9% respectively. However, the compound annual growth rates (CAGR) showed numbers that were in line with the graph presented in Figure 5.1. TAAE yielded 14.3%, while the other two strategies yielded 13%. The Sharpe ratio supported these observations. The table also shows the different return, volatility and risk measurements for each strategy. Standard deviation represents the volatility of specified strategies. It should be noted that TAA showed reduced volatility. This was supported by the reduction in risk shown by the ulcer index and maximum drawdown value over the period. TAAE and TAAI experienced a 44.2% and 47.7% drawdown value that was approximately 26% less than the B&H value.

The table showed that using a TAA on the ALSI from 1961 to 2010 would have exposed an investor to the market for 70% of the time, while only making an average trade every 15 months.

Figure 5.2 Frequency Distribution for Yearly Returns using ALSI

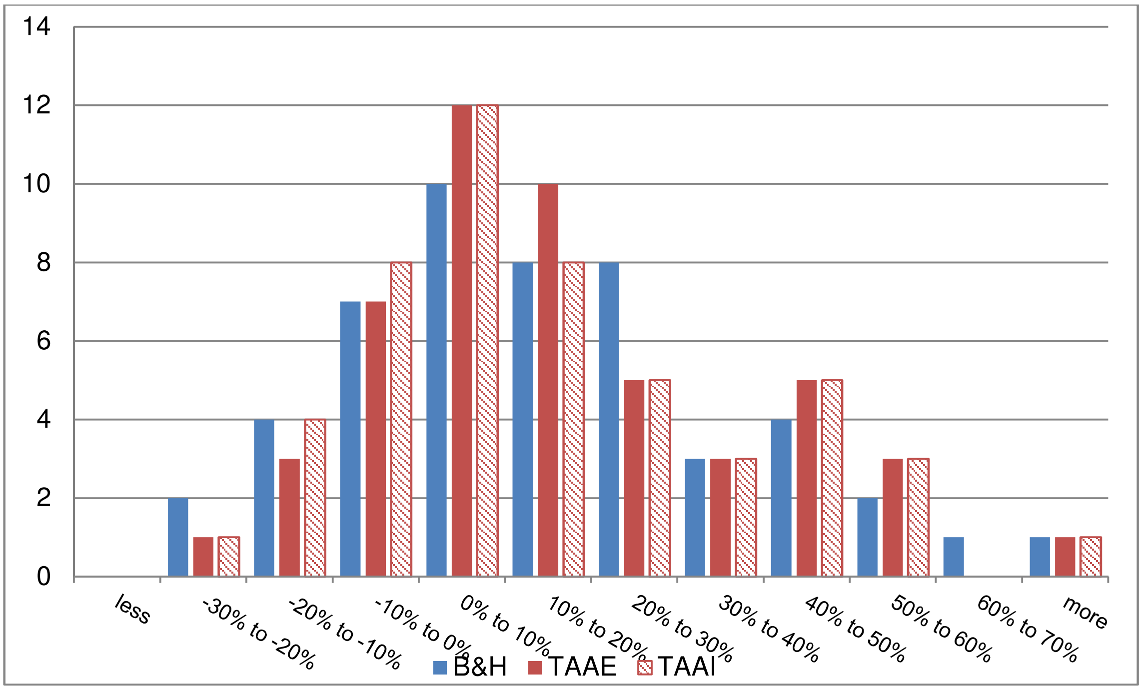


Figure 5.2 shows the frequency distribution for the annual returns for all strategies from 1960 to 2010, using the ALSI. Negative returns appeared to be reduced in TAAs, while positive returns appeared to be similar or slightly less.

Figure 5.3 Scatterplot of Excess Returns for ALSI using TAAE

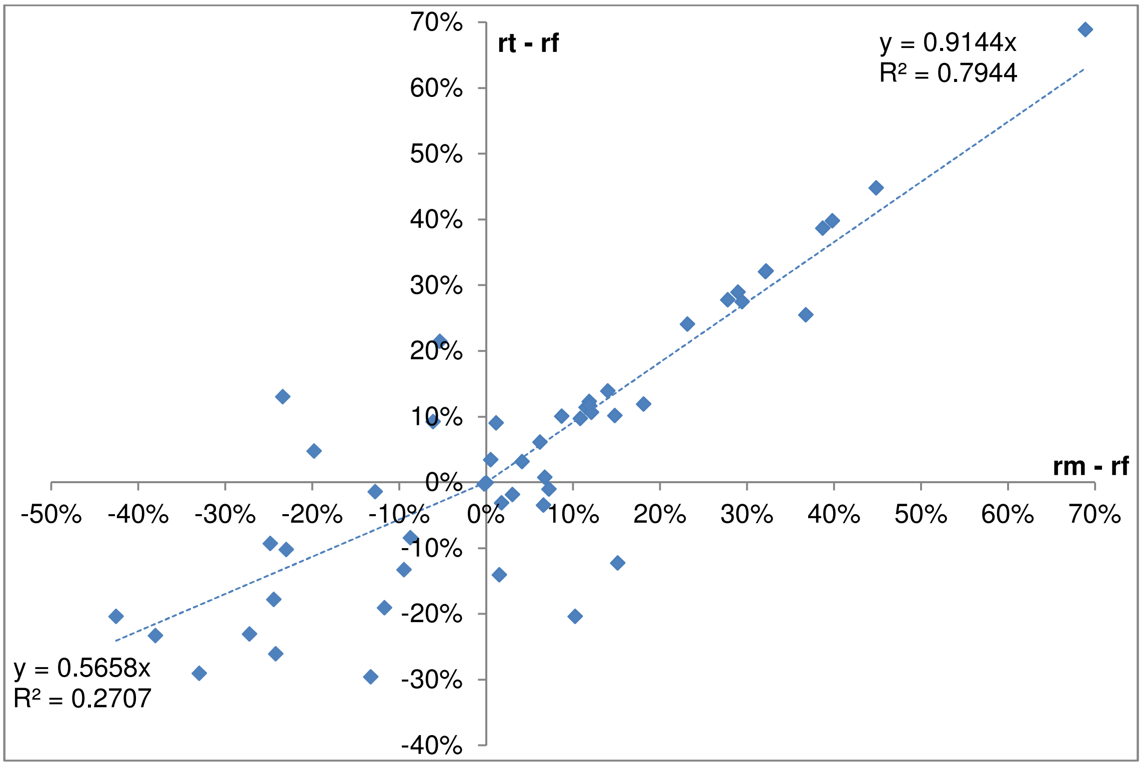


Figure 5.4 Scatterplot of Excess Returns for ALSI using TAAI

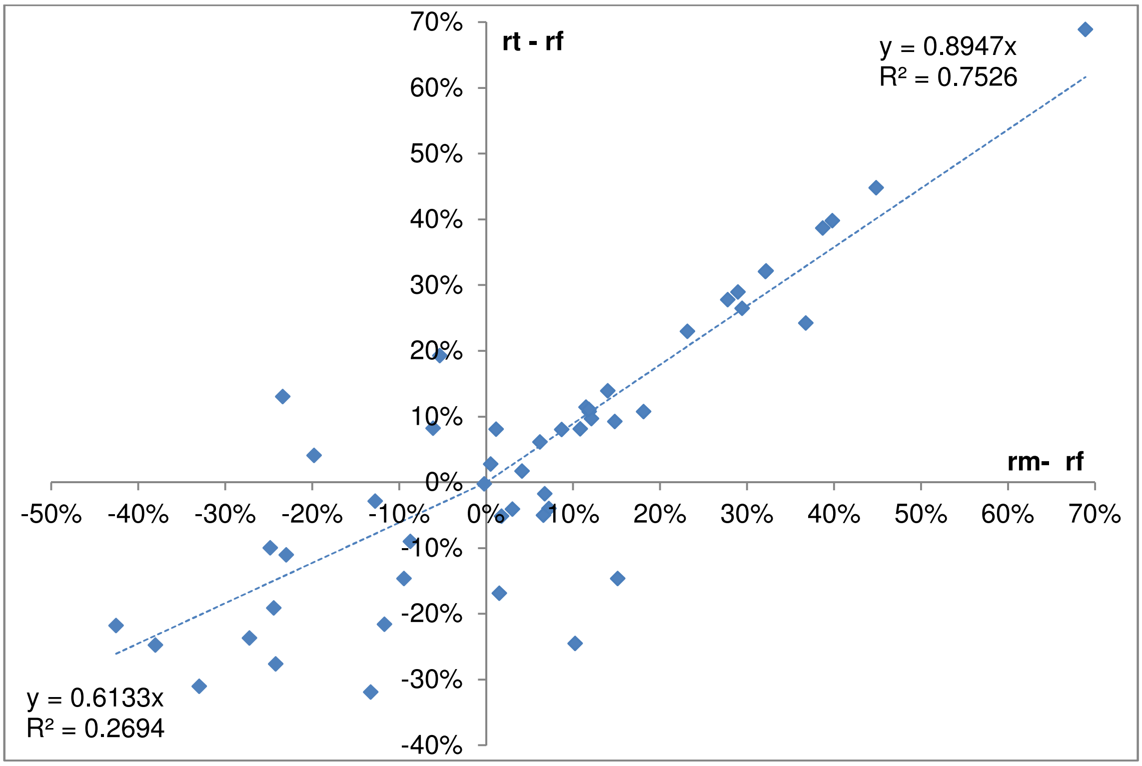


Figure 5.3 and Figure 5.4 show excess returns for TAAE and TAAI using the ALSI. These returns were plotted against excess returns for B&H. Excess returns were calculated by subtracting risk-free returns from each strategy. Returns on government bonds were used for the risk-free rate. A trend line was plotted for both positive and negative market returns in each figure. A linear relationship can be seen between positive market returns and TAA returns. There is very little correlation between negative market returns and corresponding TAA returns. Trend line slopes greater than one, for positive market returns illustrate increased positive returns for TAA. Slopes less than one, for negative market returns, illustrate reduced negative returns for TAA.

5.2 Results for Different Tactical Asset Allocation Strategies

TAA used within this research was based on a ten-month simple moving average (SMA). Faber (2007) derived this average from a 200-day simple moving average used in Siegel's (2008) earlier works. The origins of the 200-days simple moving average were unclear and could have been optimised by looking back over a test period. These works were based on the United States and foreign stock markets.

Table 5.4 Comparison of TAAE Strategies based on Different Periods of SMA

	B&H	SMA 4	SMA 6	SMA 8	SMA 10	SMA 12
Annualised Mean	14.6%	16.2%	16.7%	15.8%	14.9%	14.5%
CAGR	13.0%	16.1%	16.6%	15.6%	14.3%	13.9%
Sharpe	0.22	0.40	0.43	0.37	0.29	0.27
Standard Deviation	21.3%	15.6%	15.7%	15.6%	16.6%	16.8%
Ulcer Index	20.0%	12.6%	9.6%	11.6%	14.7%	15.3%
Max Drawdown	62.3%	41.7%	31.5%	36.5%	44.2%	45.2%
Time In Market	100%	66%	68%	68%	70%	71%
Trades/Year		1.52	1.00	0.88	0.80	0.74

Table 5.5 Comparison of TAAI Strategies based on Different Periods of SMA

	B&H	SMA 4	SMA 6	SMA 8	SMA 10	SMA 12
Annualised Mean	14.6%	14.1%	15.4%	14.6%	13.8%	13.5%
CAGR	13.0%	13.6%	15.0%	14.2%	13.0%	12.7%
Sharpe	0.22	0.26	0.34	0.29	0.22	0.21
Standard Deviation	21.3%	16.1%	16.0%	15.9%	16.9%	17.1%
Ulcer Index	20.0%	14.9%	11.3%	13.4%	16.4%	17.0%
Max Draw Down	62.3%	48.4%	35.7%	41.3%	47.7%	47.9%
Time In Market	100%	66%	68%	68%	70%	71%
Trades/Year		1.52	1.00	0.88	0.80	0.74

Table 5.4 and Table 5.5 show TAAE and TAAI using different simple moving averages on the ALSI, from 1961 to 2010. The results in both cases indicated that a six-month simple moving average would have yielded the optimal

strategy for the period. The compound annual growth rate (CAGR) for the strategy, using a six-month simple average, yielded 15% in comparison with 13% of the B&H. The second-best performing TAAE used a four-month simple moving average. However its compound annual growth rate returns dropped from 16.1% to 13.6% when costs were included.

Figure 5.5 and Figure 5.6 graphically illustrate the returns of different TAAEs and TAAIs. The graphs clearly show the superiority of the strategies using a six-month simple moving average. The four-month simple moving average performance was also tracked. Figure 5.6 shows its deterioration with the inclusion of costs.

Figure 5.5 Plot of Returns for ALSI using TAAE based on Different SMA

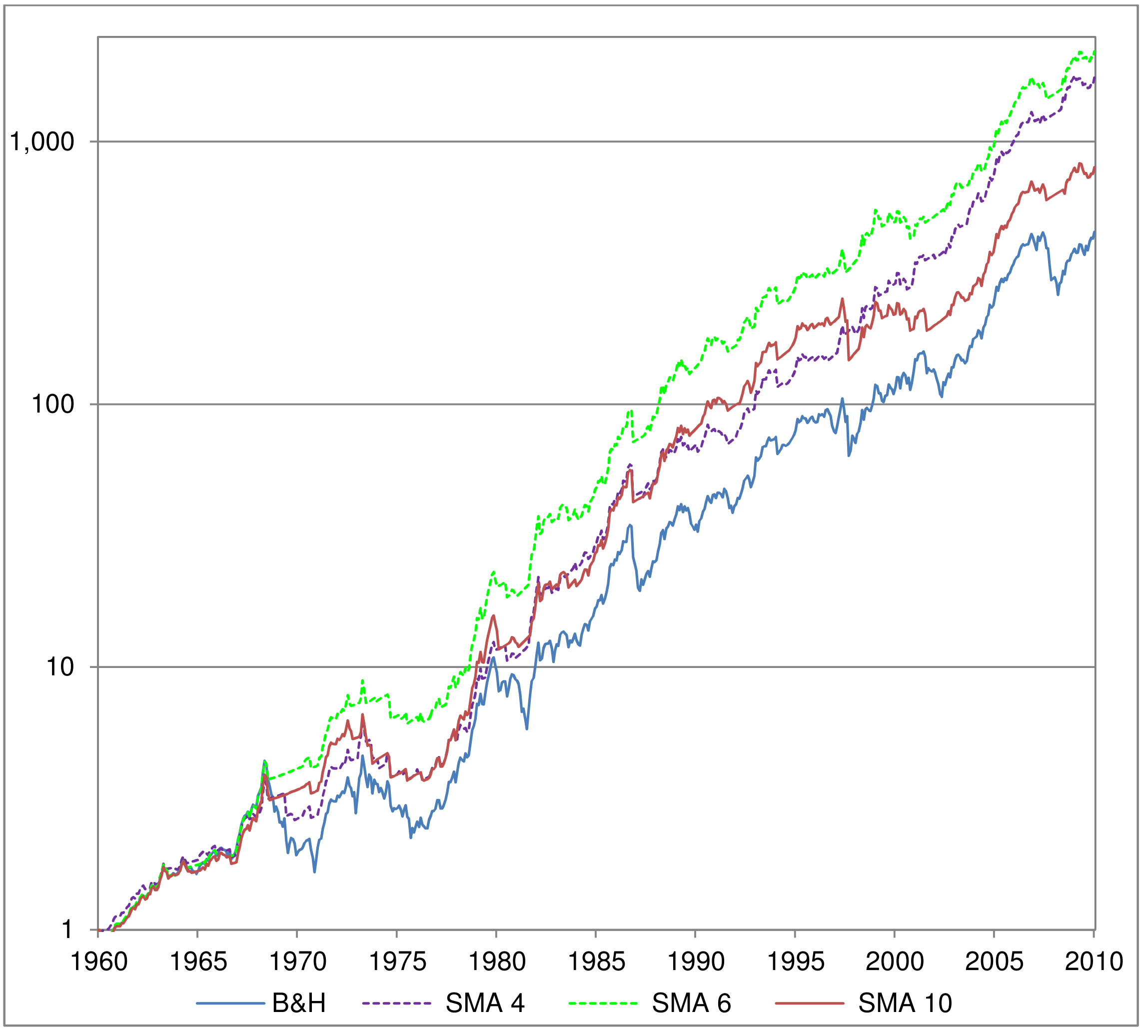
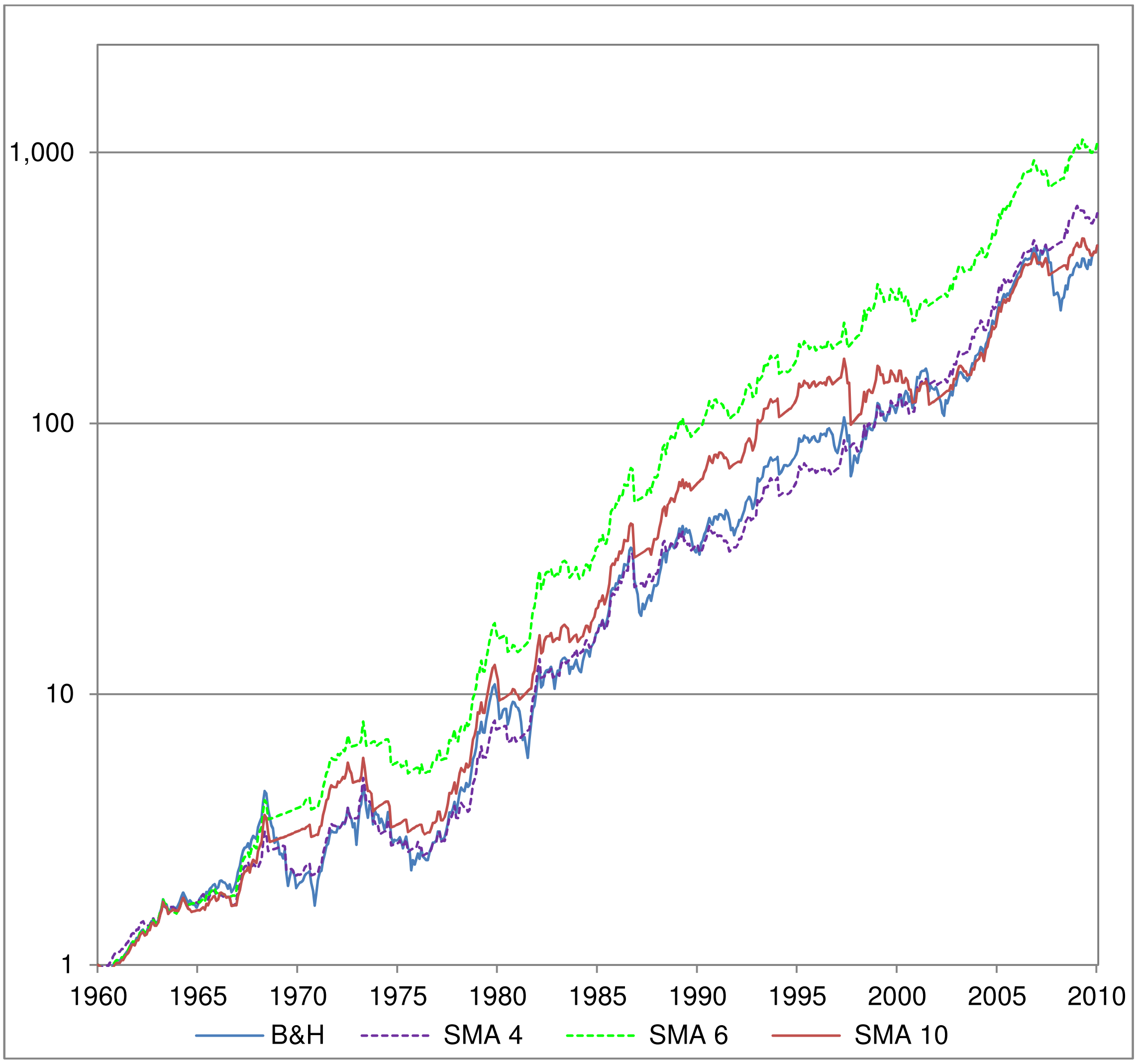


Figure 5.6 Plot of Returns for ALSI using TAAI based on Different SMA



5.3 Results for Equities and Other Asset Classes

The All Share Index (ALSI) consists of two major sectors within the South African economy. These sectors are represented by their own indices, the Financial & Industrial Index (FINI) and the Resource Index (RESI). Other asset classes were included using specific indices as a proxy to represent their historical performance. The Africa Gold Mining Index (AGMI) was included to represent commodities, the Government Bond Index (GOVI) was included to represent bonds and the Property Unit Trust Index (PUTI) to represent real estate. Comparisons were made between B&Hs and TAAs. Results for strategies excluding and including costs were shown. The study continued with a ten-month simple moving average for reasons mentioned within the discussion.

Table 5.6 to Table 5.10 compare B&Hs against TAAs for FINI, RESI, AGMI and GOVI over the period of 1961 to 2010. Results for PUTI were generated from 1977 to 2010. Figure 5.7 to Figure 5.16 shows on the returns for investments and their frequency distribution.

5.3.1 Financial & Industrial Index

Table 5.6 Comparison of Strategies for FINI from 1961 to 2010

	B&H	TAAE	TAAI
Annualised Mean	14.3%	15.7%	14.7%
CAGR	13.0%	15.5%	14.3%
Sharpe	0.22	0.37	0.30
Standard Deviation	19.8%	15.4%	15.7%
Ulcer Index	25.8%	14.7%	16.6%
Max Drawdown	65.5%	43.3%	49.8%
Time In Market	100%	71%	
Trades/Year		0.72	

Figure 5.7 Plot of Returns for Investments Strategies using FINI

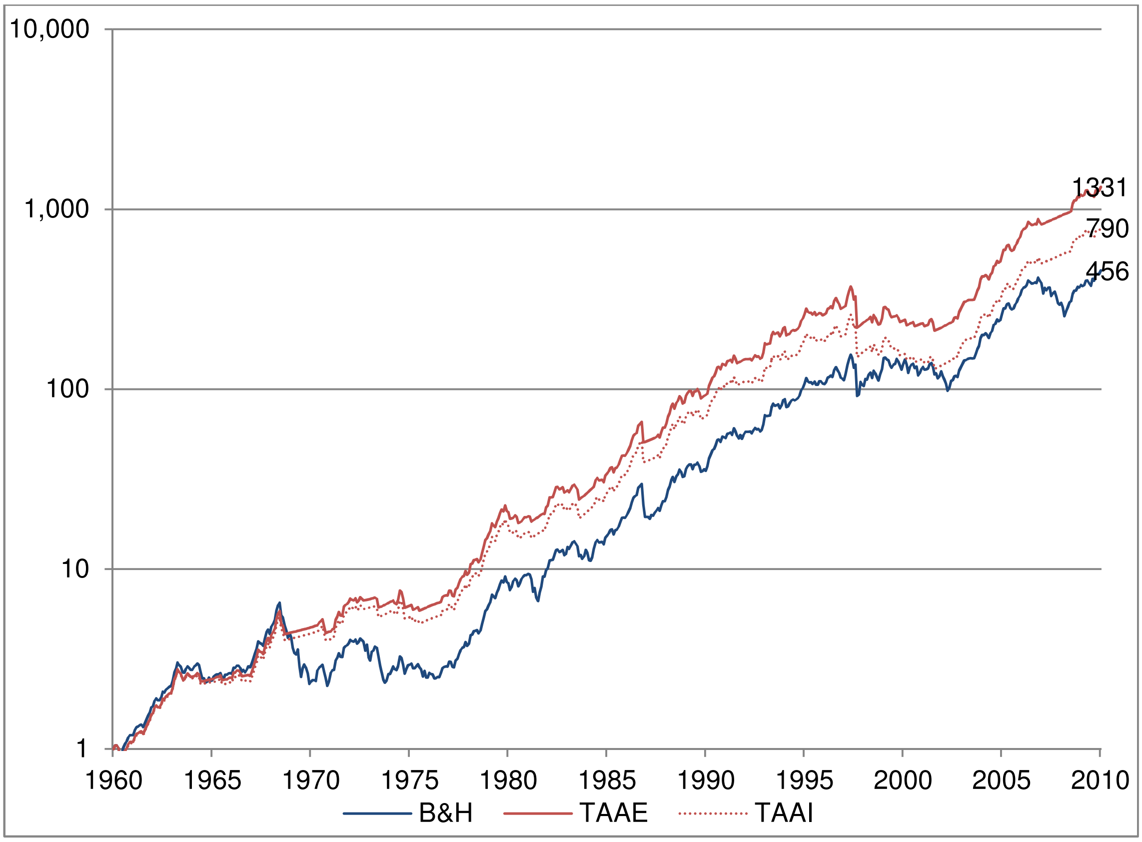


Figure 5.7 plots the returns for FINI from 1961 to 2010. At first glance the graph presented a similar picture to the returns of ALSI represented by Figure 5.1. From the period of 1969 to 1998 the gap in returns expanded. However compared with ALSI, the returns for FINI were more pronounced over the same period. Both TAAE and TAAI results for FINI although much improved tracked

closely too movements in B&H during this period. After 1998 the gap in returns narrowed, but the returns still outperformed B&H at all times over the investment period. The net returns for the period showed TAAE exceeded B&H returns by 2.9 times. The net returns for TAAI exceeded B&H returns by 1.7 times.

Figure 5.8 Frequency Distribution for Yearly Returns using FINI

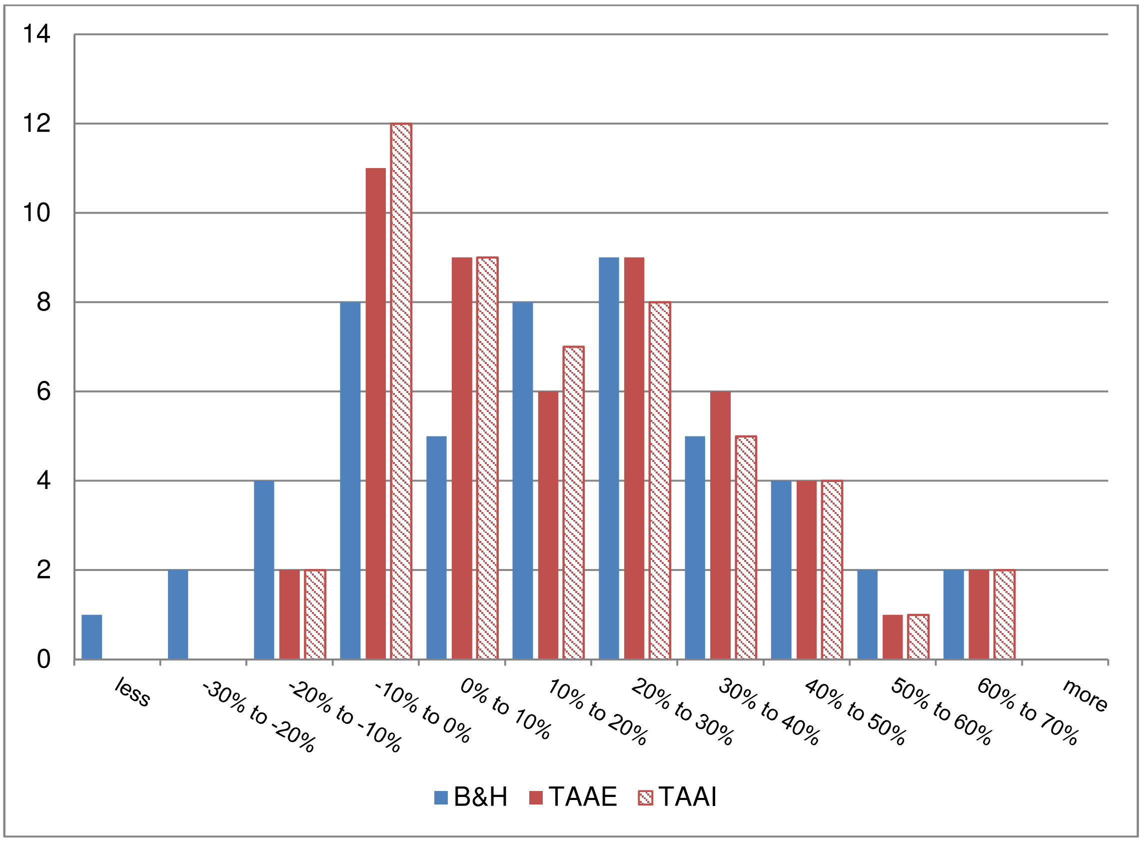


Figure 5.8 shows the frequency distribution for the yearly returns for all strategies using FINI, from 1960 to 2010. The B&H appeared to be normally distributed and spanned between -40% and 70%. However, the TAAs were slightly skewed. The majority of losses were kept under -10%. The gains of all strategies appeared to be closely matched.

5.3.2 Resource Index

Table 5.7 Comparison of Strategies for RESI from 1961 to 2010

	B&H	TAAE	TAAI
Annualised Mean	16.1%	17.2%	16.1%
CAGR	13.0%	15.9%	14.6%
Sharpe	0.22	0.33	0.28
Standard Deviation	27.9%	21.8%	22.1%
Ulcer Index	24.3%	15.0%	16.4%
Max Drawdown	58.8%	45.9%	50.0%
Time In Market	100%	67%	
Trades/Year		0.80	

Figure 5.9 Plot of Returns for Investments Strategies using RESI

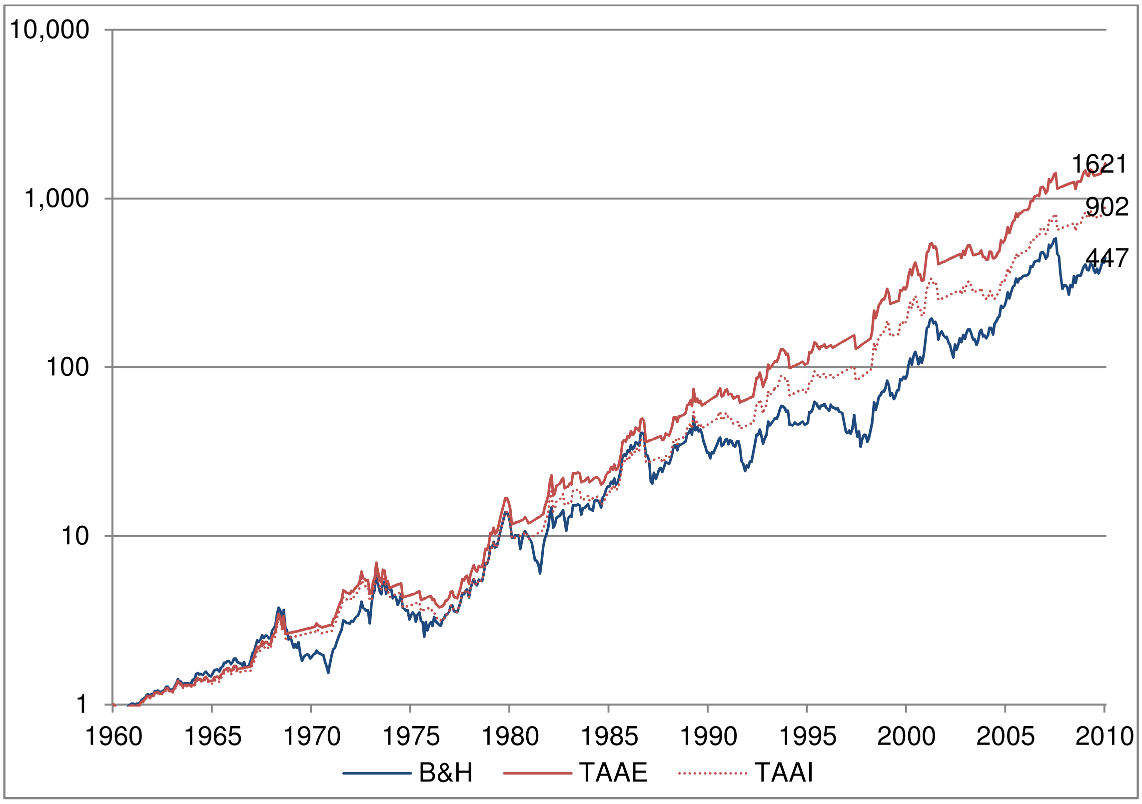


Figure 5.9 plots the returns for RESI from 1961 to 2010. From 1969, the superiority of TAAE is evident. This advantage was maintained all the way to 2010. The returns in TAAI fluctuated but closely matched B&H up until 1989, thereafter breaking away and yielded superior returns. Both TAAs results showed the ability to reduce investment risks over the period. From the graph it is evident that drawdowns were averted throughout the investment period.

Figure 5.10 Frequency Distribution for Yearly Returns using RESI

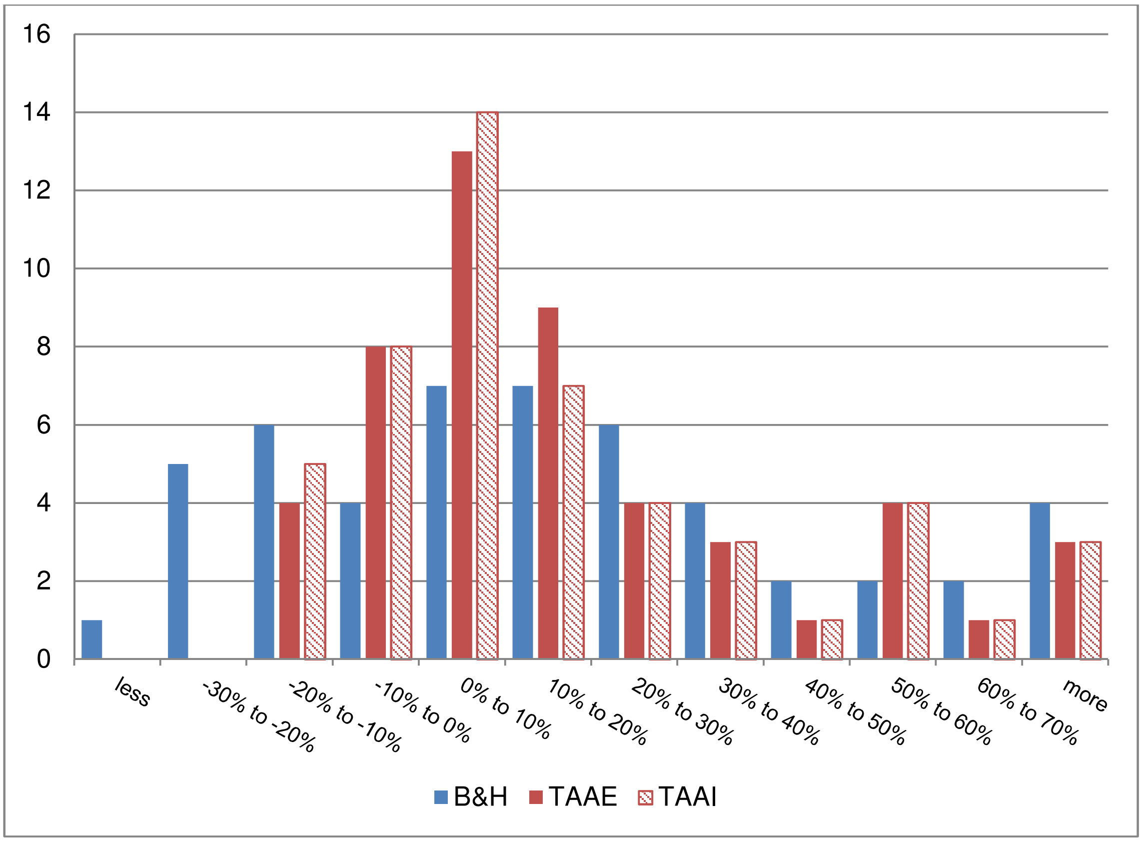


Figure 5.10 shows the frequency distribution on the yearly returns for all strategies using RESI from 1960 to 2010. B&H returns were widely spread, but appeared normally distributed. Returns ranged from -40% to 70%. Returns from TAA's were slightly skewed but also appeared normally distributed. Their range in returns was more concentrated. Returns ranged from -20% to 70% with the greatest concentration of returns between 0% and 10%. Outliers did exist, with a small concentration in returns between 50% and 60%.

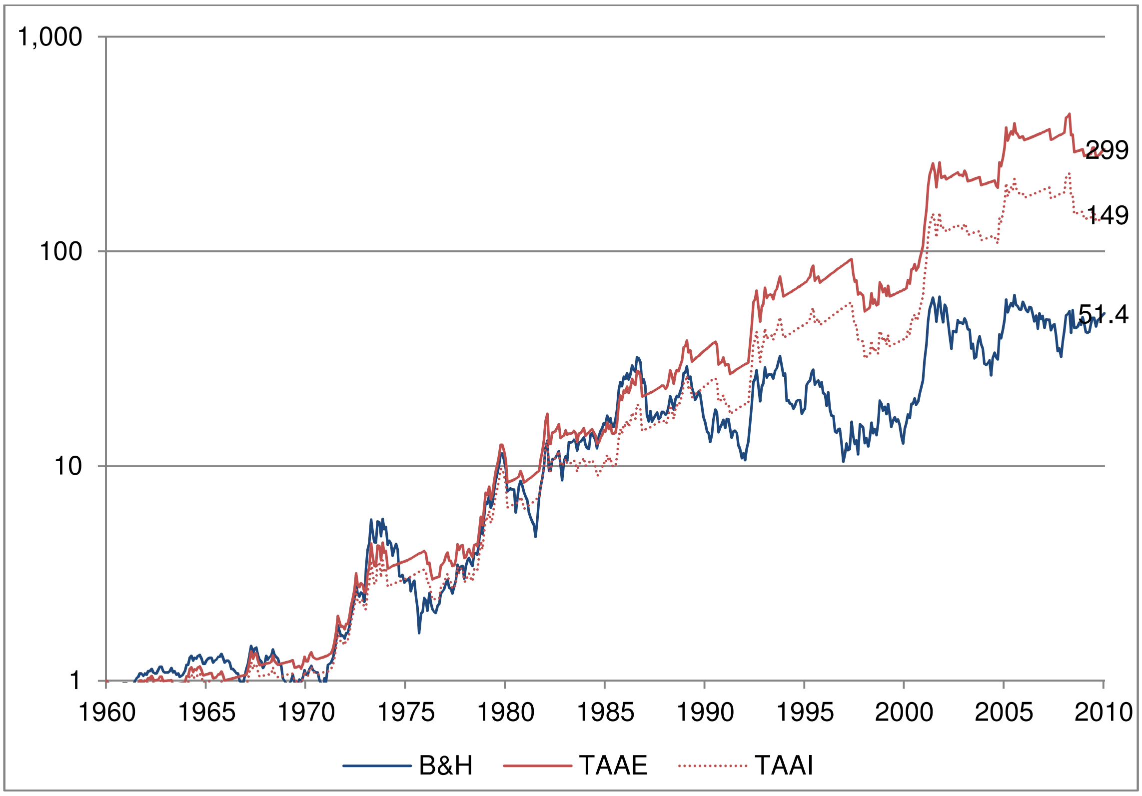
5.3.3 Africa Gold Mining Index

Table 5.8 Comparison of Strategies for AGMI from 1961 to 2010

	B&H	TAAE	TAAI
Annualised Mean	13.7%	14.4%	13.0%
CAGR	8.2%	12.1%	10.5%
Sharpe	0.11	0.18	0.12
Standard Deviation	34.5%	24.5%	24.8%
Ulcer Index	32.4%	16.5%	18.3%
Max Drawdown	70.6%	42.9%	44.9%
Time In Market	100%	56%	
Trades/Year		0.96	

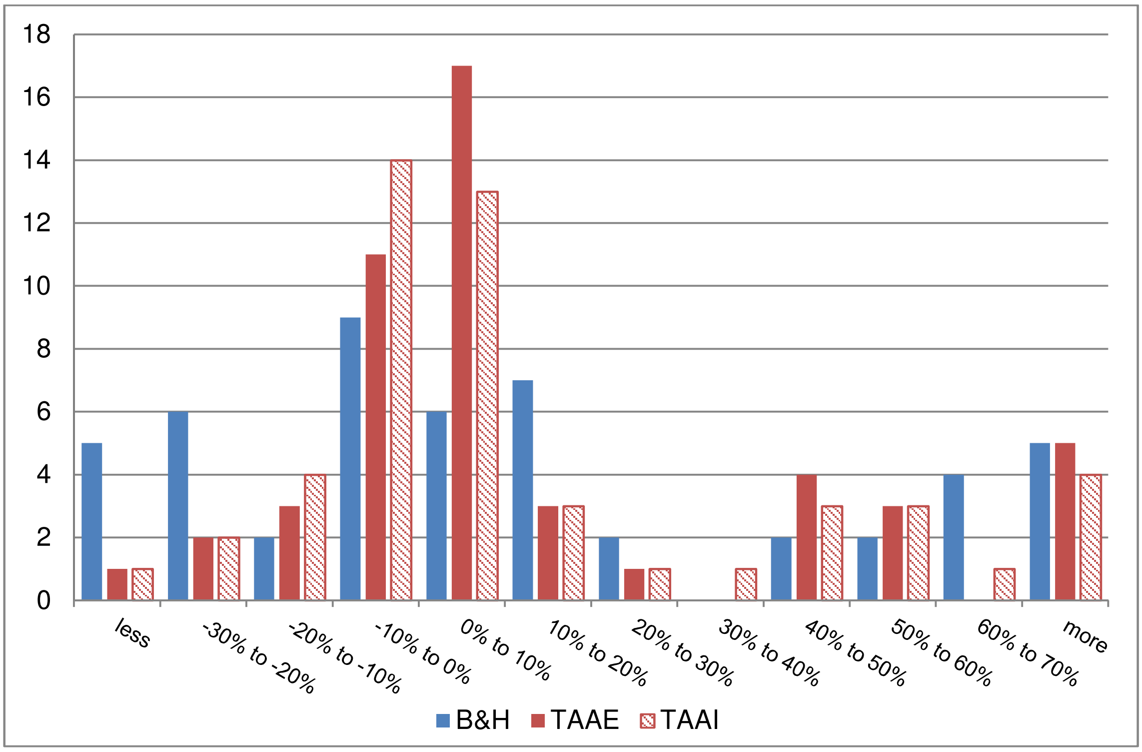
B&H for the AGMI presented a different picture. The index appeared to be more volatile, and returns were more scattered. Figure 5.11 plots the returns for AGMI from 1961 to 2010. The superiority of TAA returns was evident from 1989 onwards. Before 1989, returns fluctuated but tracked closely.

Figure 5.11 Plot of Returns for Investments Strategies using AGMI



The graph shows large portions of the index's volatility being removed using TAA. This was illustrated by the squared heartbeat pattern of the strategy's returns. Table 5.8 shows the percentage time in market at 56%. Standard deviation was reduced by 29%. The results confirmed these observations. Net returns for the period showed that TAAE outperformed B&H by 5.8 times. TAAI outperformed B&H by 2.9 times.

Figure 5.12 Frequency Distribution for Yearly Returns using AGMI



The frequency distribution in Figure 5.12 does not appear normally distributed. The B&H appears to be represented by three concentrations. 'Lose big', normal losses and gains and 'win big'. However, TAA appears to have removed the 'lose big' concentration from the investment. TAA takes the shape of a normal distribution but does not remove the positive outliers. The largest concentration of returns is between 0% and 10%. The range of returns for all strategies is large. Returns range from -50% to 170% for B&H. Returns for TAAE and TAAI were slightly more concentrated and ranged from -40% to 125%.

5.3.4 Government Bond Index

Table 5.9 Comparison of Strategies for GOVI from 1961 to 2010

	B&H	TAAE	TAAI
Annualised Mean	10.0%	11.1%	10.5%
CAGR	10.2%	11.5%	10.8%
Sharpe	0.00	0.17	0.08
Standard Deviation	7.8%	6.4%	6.6%
Ulcer Index	4.2%	2.0%	2.3%
Max Drawdown	22.3%	9.6%	10.1%
Time In Market	100%	82%	
Trades/Year		0.44	

Bonds have traditionally been referred to as a risk-free investment. However, as seen in Table 5.9, an investment in GOVI using a B&H from 1961 to 2010 would have experienced a maximum drawdown of 22.3%. Figure 5.13 plots the returns for GOVI from 1961 to 2010. The graph shows that TAA yielded superior returns from the beginning of the investment. TAA appears to remove any drawdown spikes shown in the B&H. Net return for TAAE exceeded B&H by 1.8 times. Net returns for TAAI exceeded B&H by 1.3 times.

Figure 5.13 Plot of Returns for Investments Strategies using GOVI

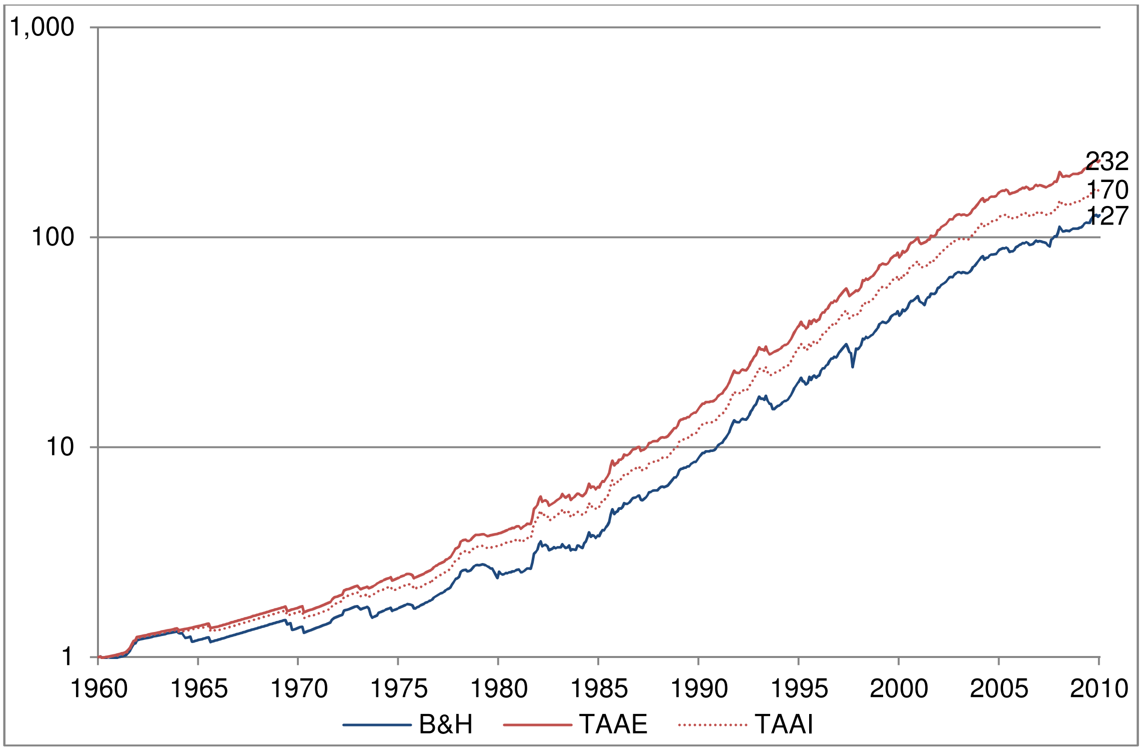


Figure 5.14 Frequency Distribution for Yearly Returns using GOVI

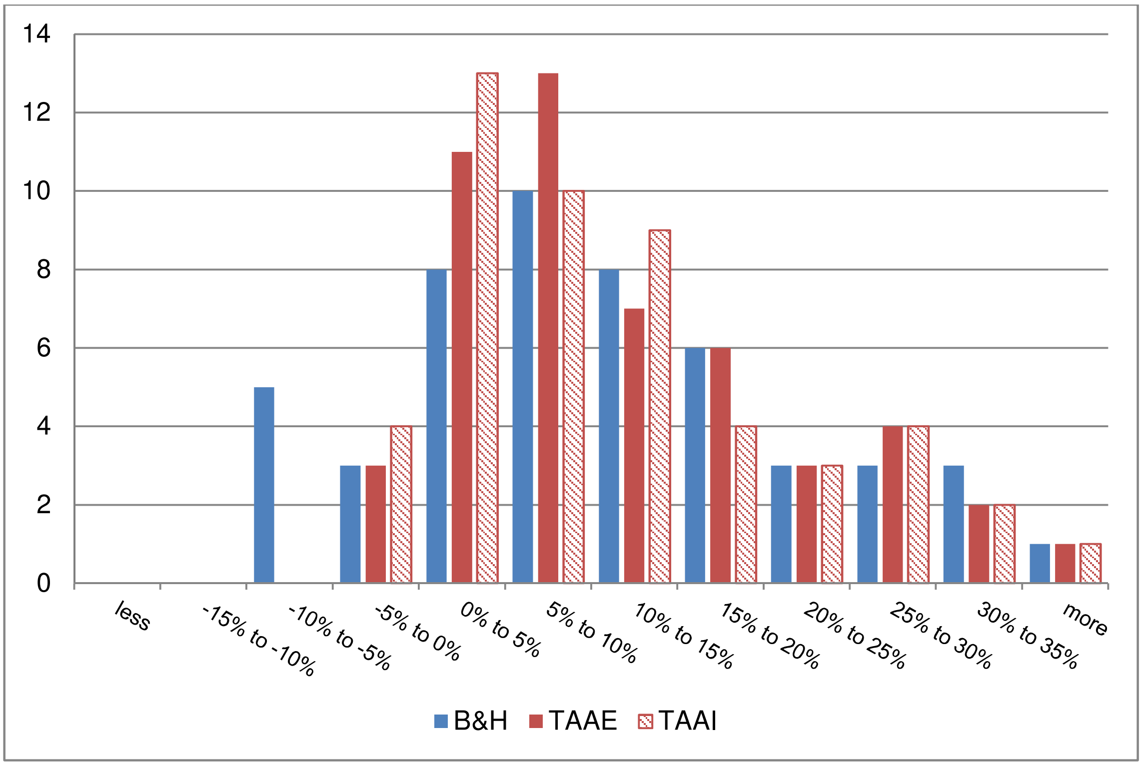


Figure 5.14 shows the frequency distribution for the yearly returns for all strategies using GOVI, from 1960 to 2010. Due to the concentration in returns, the frequency distribution was generated using 5% intervals. All strategies appear to be normally distributed, with TAA being slightly skewed. It can be seen that TAA has reduced the negative returns, while maintaining the positive.

5.3.5 Property Unit Trust Index

Table 5.10 Comparison of Strategies for PUTI from 1977 to 2010

	B&H	TAAE	TAAI
Annualised Mean	8.3%	11.0%	9.9%
CAGR	5.5%	10.2%	9.0%
Sharpe	-0.09	0.07	-0.01
Standard Deviation	19.5%	14.3%	14.6%
Ulcer Index	23.4%	10.0%	12.6%
Max Drawdown	61.5%	23.8%	29.3%
Time In Market	100%	62%	
Trades/Year		0.82	

Figure 5.15 Plot of Returns for Investments Strategies using PUTI

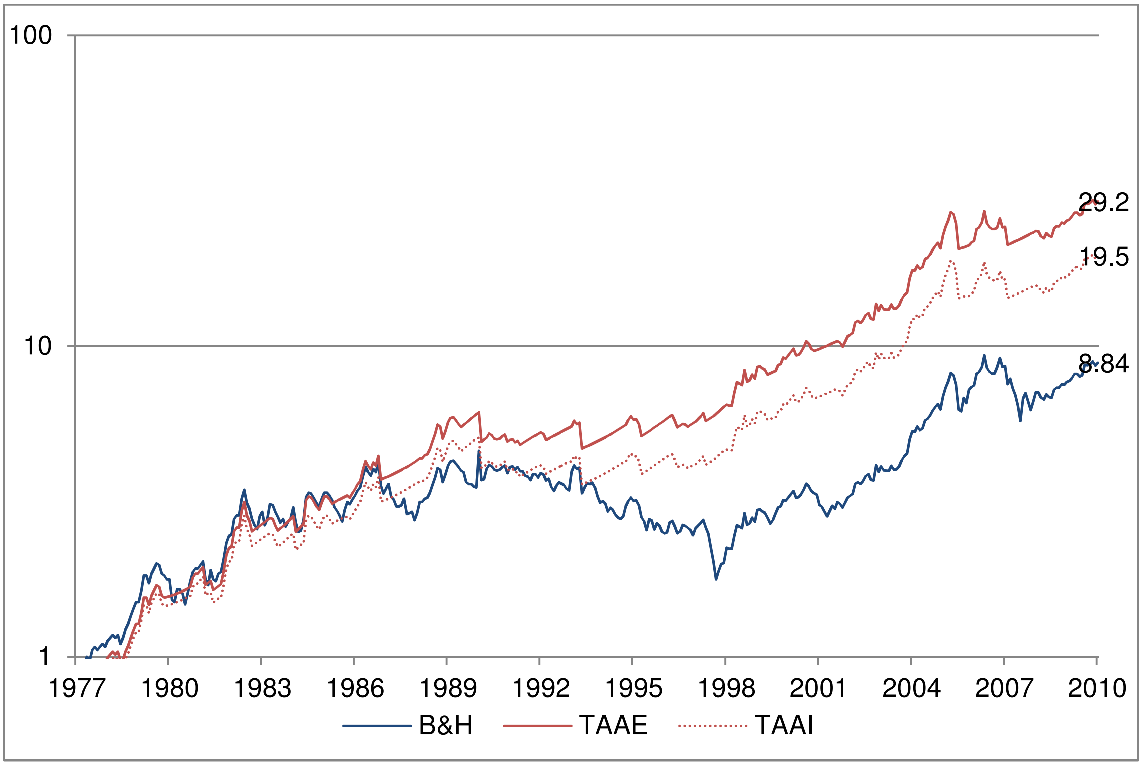


Figure 5.15 plots the returns for PUTI, from 1977 to 2010. For the first three years of investment, the TAA returns were below B&H. Thereafter the strategies ran parallel for seven years to 1987. In 1987 TAAE moved ahead. TAAI only managed to pull away in 1994. However, the net returns over the investment period show the strategy's superiority. TAAE outperformed B&H by 3.3 times. TAAI outperformed B&H by 2.2 times.

Figure 5.16 Frequency Distribution for Yearly Returns using PUTI

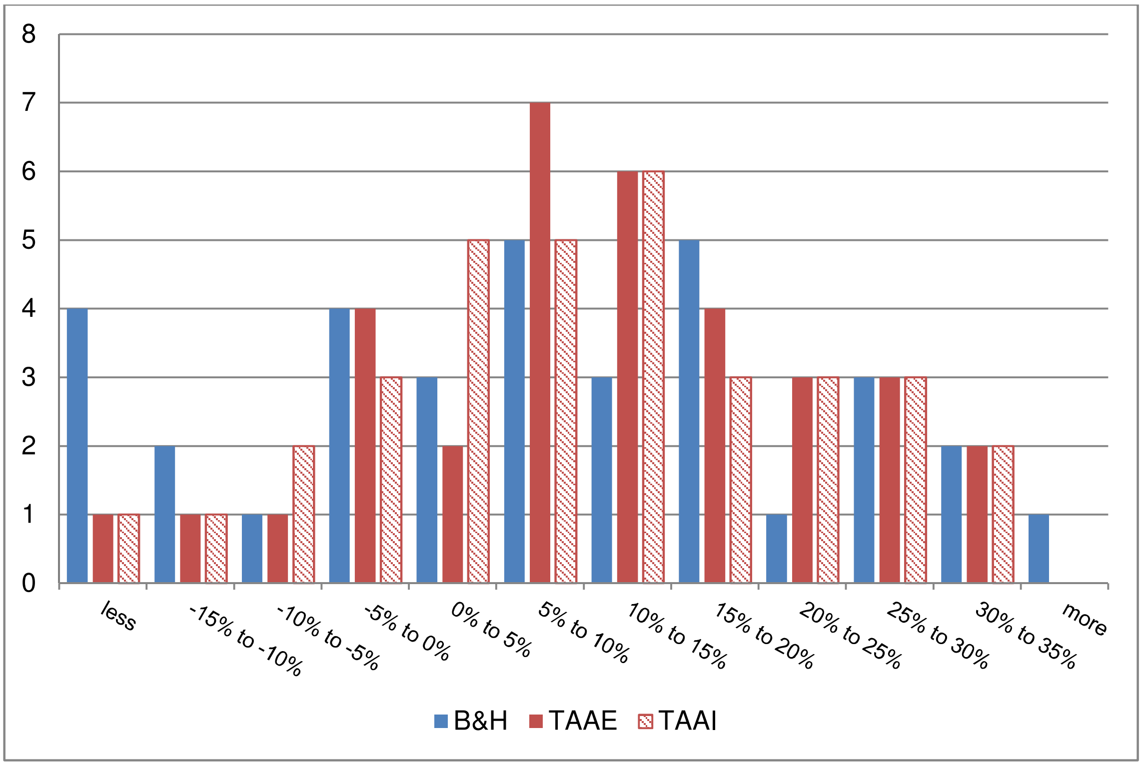


Figure 5.16 shows the frequency distribution of the yearly returns for all strategies using PUTI from 1977 to 2010. A 5% interval was used to generate frequency distribution. All strategies appear to be normally distributed. B&H returns were widely spread and range between -25% and 45%. TAAs had a narrower spread and ranged between -15% and 35%.

5.4 Results for Segmented Comparison of Strategies by Decade

Table 5.11, Table 5.12 and Table 5.13 show different returns, volatilities and risk measurements for each strategy segmented by decade. Figure 5.17 to Figure 5.22 illustrate a graphical representation of the returns for each decade. Returns and risk measurements for each strategy varied over the different decades. However, each TAA reduced in volatility, across all decades and asset classes.

5.4.1 All Share and Financial & Industrial Indices

ALSI and FINI have been paired together in Table 5.11. TAA yielded inferior results for both its returns and risk measurements between 1991 and 2000. TAAI yielded equivalent returns on ALSI from 1961 to 2010 (see Table 5.3). Examining Table 5.11 shows that the strategy produced inferior returns in three out of five decades. However the strategy reduced risk across four out of the five decades. Figure 5.17 shows all strategies tracked closely from 1991 to 2000. It was only in the market crash of 1998 that TAA failed to reduce the maximum drawdown.

The TAAs yielded varied results for FINI. The TAAEs yielded superior returns for four out of five decades. However the inclusion of costs eroded returns in the 1980s. Figure 5.18 shows the strategies tracked closely from 1981 to 1990. Differences in returns were minimal. The period between 2001 and 2010 shows superior returns but inferior risk avoidance. Figure 5.18 does not provide any insight into this anomaly.

Table 5.11 Segmented Comparison of Strategies for ALSI and FINI

	ALSI			FINI		
	B&H	TAAE	TAAI	B&H	TAAE	TAAI
1961 to 1970						
Annualised Mean	8.3%	13.1%	12.2%	10.7%	16.7%	16.0%
CAGR	7.0%	13.1%	12.0%	9.0%	16.8%	15.9%
Sharpe	0.48	1.08	0.99	0.53	1.15	1.08
Standard Deviation	17.2%	12.1%	12.3%	20.0%	14.6%	14.8%
Ulcer Index	17.5%	7.6%	8.1%	20.3%	10.7%	11.7%
Max Drawdown	56.3%	20.1%	20.6%	64.6%	25.5%	26.0%
1971 to 1980						
Annualised Mean	18.8%	15.7%	14.7%	14.7%	16.0%	15.0%
CAGR	17.1%	15.0%	13.7%	13.4%	15.9%	14.8%
Sharpe	0.77	0.85	0.78	0.72	1.05	0.98
Standard Deviation	24.3%	18.6%	18.8%	20.5%	15.2%	15.4%
Ulcer Index	32.6%	24.8%	27.0%	48.6%	11.2%	12.6%
Max Drawdown	62.4%	44.2%	47.7%	65.5%	24.3%	25.9%
1981 to 1990						
Annualised Mean	16.0%	19.6%	18.7%	16.6%	16.5%	15.6%
CAGR	13.8%	19.3%	18.2%	15.5%	16.2%	15.1%
Sharpe	0.66	1.04	0.98	0.82	1.02	0.95
Standard Deviation	24.4%	18.9%	19.2%	20.4%	16.1%	16.4%
Ulcer Index	17.6%	11.9%	12.5%	12.9%	9.9%	10.9%
Max Drawdown	46.7%	25.7%	26.2%	36.0%	23.2%	23.7%
1991 to 2000						
Annualised Mean	14.3%	11.9%	10.5%	16.0%	11.5%	9.9%
CAGR	12.8%	10.6%	9.1%	14.6%	10.0%	8.2%
Sharpe	0.69	0.65	0.57	0.77	0.61	0.52
Standard Deviation	20.7%	18.3%	18.6%	20.8%	18.9%	19.2%
Ulcer Index	10.7%	12.7%	13.8%	11.7%	17.2%	18.3%
Max Drawdown	39.4%	41.6%	43.0%	41.1%	41.1%	41.6%
2001 to 2010						
Annualised Mean	15.7%	14.0%	12.7%	13.6%	17.9%	17.0%
CAGR	14.7%	13.8%	12.3%	12.7%	18.7%	17.5%
Sharpe	0.80	0.97	0.86	0.78	1.53	1.42
Standard Deviation	19.5%	14.5%	14.8%	17.4%	11.7%	12.0%
Ulcer Index	14.2%	9.9%	14.2%	15.6%	21.0%	25.1%
Max Drawdown	42.0%	24.4%	32.2%	39.1%	43.3%	49.8%

Figure 5.17 Segmented Returns by Decade for ALSI Strategies

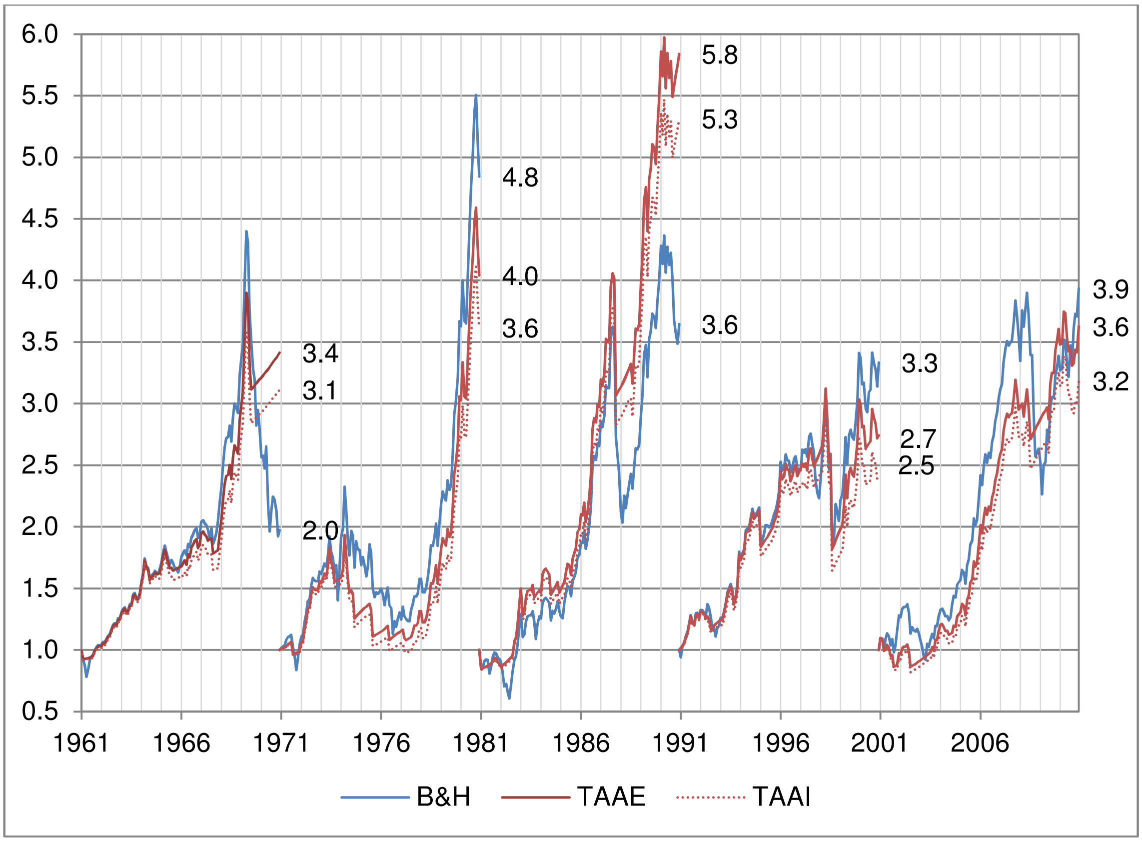
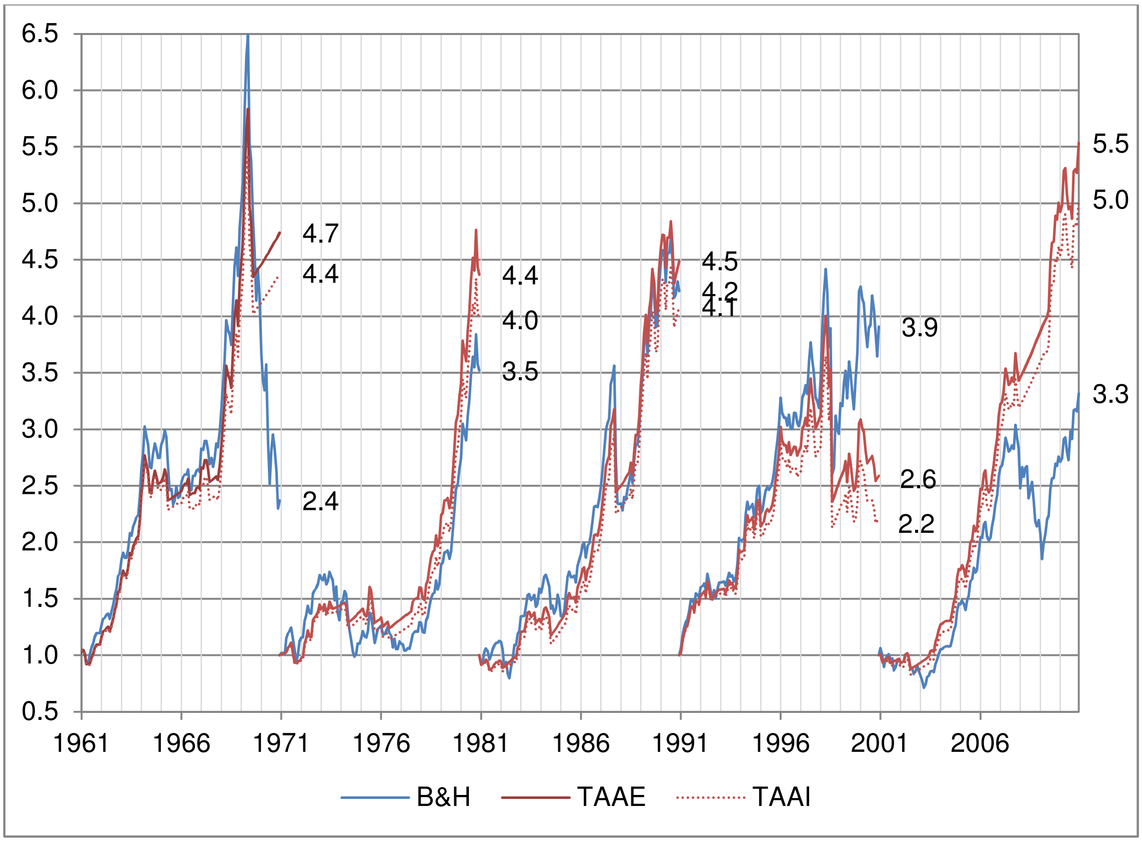


Figure 5.18 Segmented Returns by Decade for FINI Strategies



5.4.2 Resource and Africa Gold Mining Indices

RESI and AGMI were paired together in Table 5.12. The correlation in results for these two indices was the most similar over all three pairings. TAA yielded superior results for all volatility and risk measurements, across all decades. TAAE returns were superior with exception of the 1970s. Costs eroded AGMI TAAI returns during the 1960s this was also the case for RESI between 2001 and 2010. In the decades of the 1970s and the 2000s TAAs experienced lower annualised monthly means. In the 1970s the strategies had lower compound annual returns. It should be noted that in these decades the B&H strategies experienced their highest returns for both indices.

Figure 5.19 plots segmented returns per decade for RESI, from 1961 to 2010. In the 1960s strategies tracked closely up until 1969, where TAAs yielded superior returns. In the 1970s TAA tracked closely, but still underperformed over the period. In the 1980s strategies tracked closely. TAA’s managed to withstand the drawn downs of 1987 and 1990. In 1990s TAA yielded superior returns throughout the period. In the 2000s B&H outperformed TAA over the majority of the period. However, after the crash in 2008, TAA restricted the effects of the downturn and yielded superior returns for the period.

Figure 5.20 plots segmented returns per decade for AGMI from 1961 to 2010. In the first three decades (1961 and 1990) the TAA tracked closely to the B&H. However it missed the draw ups of 1974 and 1986, and also missed the drawdowns of 1975 and 1987. Over the last two decades (1991 and 2010), TAA yielded superior returns throughout these periods.

Table 5.12 Segmented Comparison of Strategies for RESI and AGMI

	RESI			AGMI		
	B&H	TAAE	TAAI	B&H	TAAE	TAAI
1961 to 1970						
Annualised Mean	8.3%	11.6%	11.0%	1.9%	2.7%	1.2%
CAGR	6.8%	11.1%	10.4%	0.6%	2.1%	0.5%
Sharpe	0.45	0.79	0.74	0.12	0.24	0.10
Standard Deviation	18.7%	14.7%	14.9%	16.0%	11.2%	11.5%
Ulcer Index	16.5%	8.4%	8.7%	14.2%	8.6%	10.3%
Max Drawdown	51.4%	23.7%	24.2%	36.7%	16.8%	20.3%
1971 to 1980						
Annualised Mean	22.8%	19.0%	17.8%	29.4%	25.8%	24.8%
CAGR	20.0%	17.5%	16.1%	24.7%	24.1%	22.9%
Sharpe	0.75	0.80	0.74	0.76	0.89	0.85
Standard Deviation	30.2%	23.6%	23.9%	38.6%	29.1%	29.3%
Ulcer Index	31.9%	24.0%	26.6%	34.7%	13.7%	15.4%
Max Drawdown	58.8%	45.9%	50.0%	70.6%	32.4%	34.8%
1981 to 1990						
Annualised Mean	14.9%	18.0%	16.9%	11.1%	15.0%	13.9%
CAGR	10.1%	15.9%	14.5%	5.1%	12.5%	11.1%
Sharpe	0.46	0.72	0.67	0.32	0.60	0.55
Standard Deviation	32.2%	25.0%	25.3%	34.9%	25.0%	25.2%
Ulcer Index	23.4%	15.8%	16.6%	28.5%	18.8%	20.2%
Max Drawdown	56.7%	30.0%	30.7%	59.1%	33.4%	34.8%
1991 to 2000						
Annualised Mean	14.4%	18.1%	16.7%	6.8%	9.8%	8.4%
CAGR	11.1%	17.0%	15.4%	-0.7%	6.7%	5.2%
Sharpe	0.52	0.83	0.76	0.17	0.38	0.32
Standard Deviation	27.9%	21.9%	22.2%	39.6%	26.0%	26.2%
Ulcer Index	24.4%	10.2%	11.1%	46.4%	20.4%	22.4%
Max Drawdown	52.1%	23.2%	23.7%	67.8%	42.9%	44.9%
2001 to 2010						
Annualised Mean	20.3%	19.4%	18.1%	19.2%	18.6%	17.0%
CAGR	17.4%	18.3%	16.7%	13.2%	16.2%	14.3%
Sharpe	0.71	0.86	0.79	0.51	0.69	0.62
Standard Deviation	28.7%	22.6%	22.9%	37.4%	27.0%	27.3%
Ulcer Index	23.1%	11.5%	12.8%	29.8%	18.3%	20.6%
Max Drawdown	53.6%	24.9%	25.4%	56.9%	36.9%	40.2%

Figure 5.19 Segmented Returns by Decade for RESI Strategies

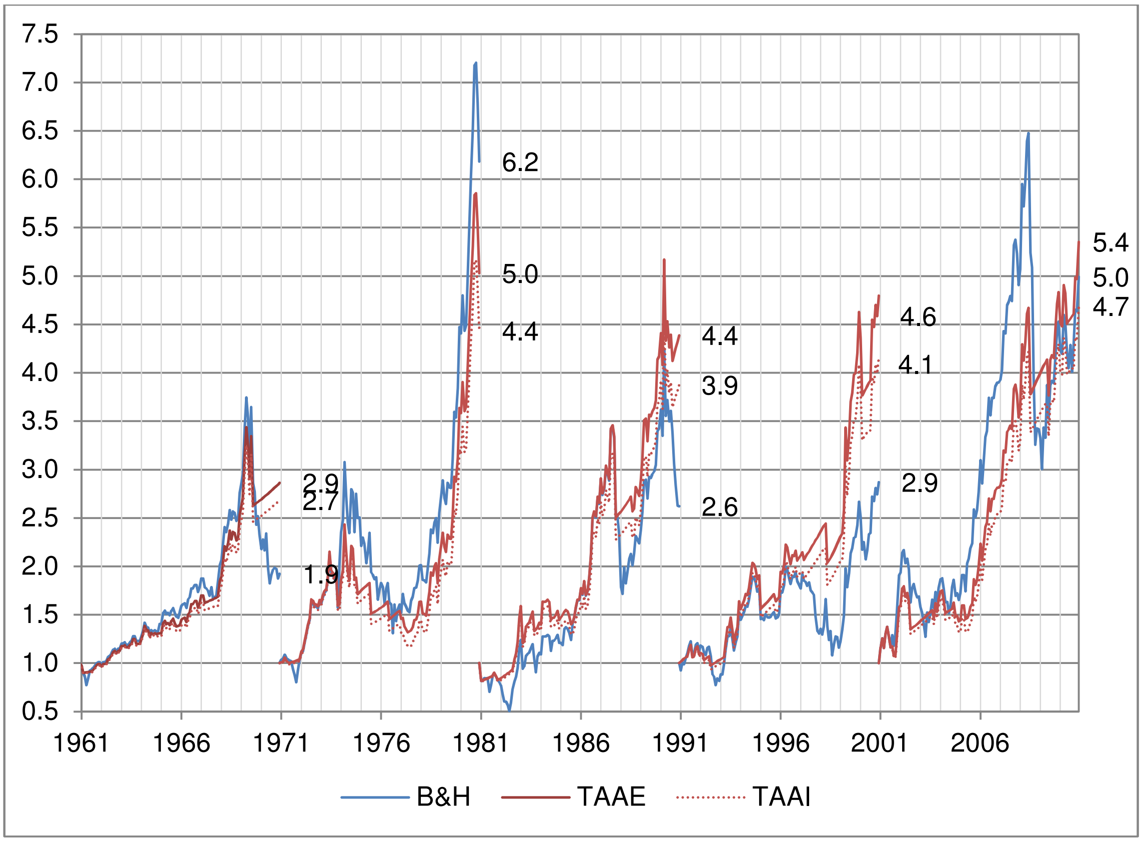
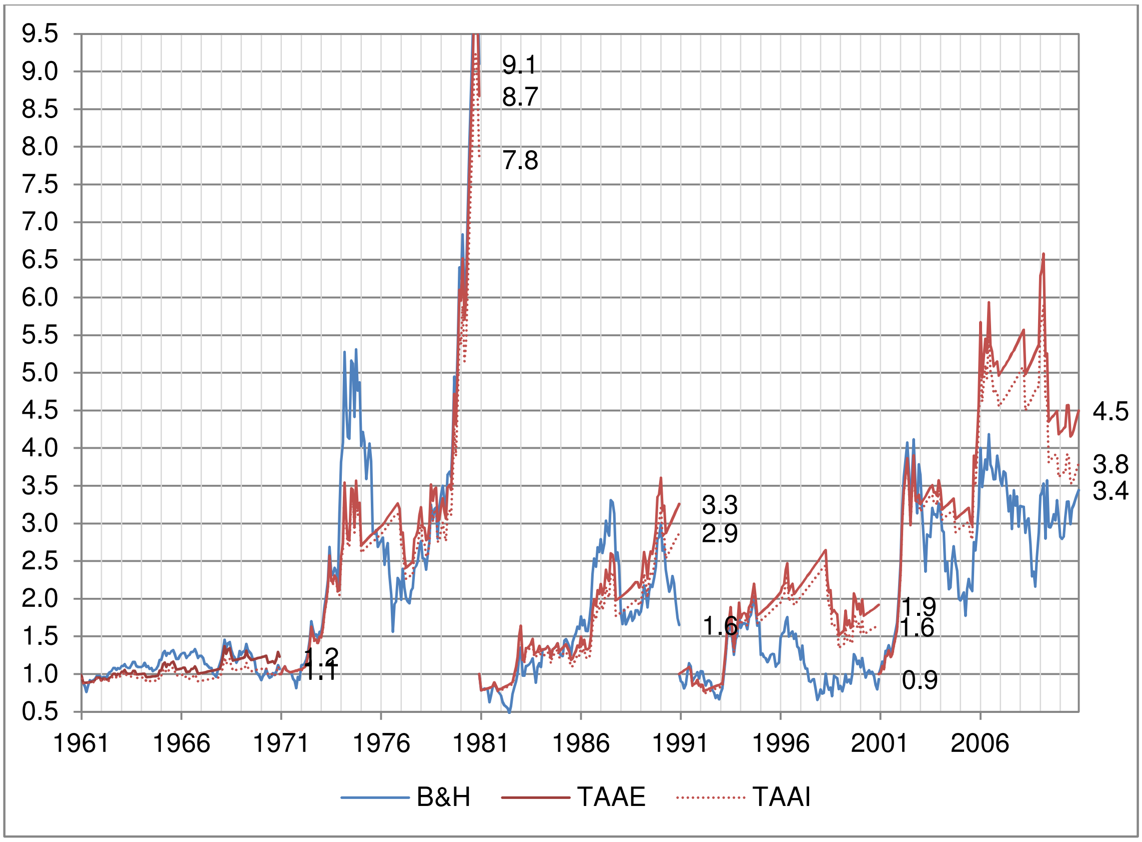


Figure 5.20 Segmented Returns by Decade for AGMI Strategies



5.4.3 Government Bond and Property Unit Trust Indices

Table 5.13 shows that TAA yielded superior results for GOVI during four out of the five decades. In the period between 2001 and 2010, B&H produced marginally higher returns. However TAA still reduced the volatility and risk of the investment over this period. TAA produced superior results for the Property Index across all decades from 1981 to 2010.

Figure 5.21 plots segmented returns per decade for GOVI, from 1961 to 2010. TAA outperformed B&H for the first four decades between 1961 and 2000. The graph shows the strategies restricted the drawdowns in 1980 and 1998. From 2001 to 2010, all strategies tracked closely. However, at the end of 2008, TAA was unable to capture the additional gains experienced by B&H. This gap was maintained for the remainder of the period.

Figure 5.22 plots segmented returns per decade for PUTI from 1981 to 2010. The graph demonstrates that TAA outperformed B&H across all three decades. It should be noted that B&H managed to catch up at the height of the property bubble in 2007, but thereafter fell away as the PUTI collapsed.

Table 5.13 Segmented Comparison of Strategies for GOVI and PUTI

	GOVI			PUTI		
	B&H	TAAE	TAAI	B&H	TAAE	TAAI
1961 to 1970						
Annualised Mean	3.3%	5.5%	5.0%			
CAGR	3.3%	5.6%	5.1%			
Sharpe	0.70	1.68	1.40			
Standard Deviation	4.7%	3.3%	3.6%			
Ulcer Index	4.6%	1.3%	1.7%			
Max Drawdown	11.0%	5.1%	5.6%			
1971 to 1980						
Annualised Mean	6.4%	8.3%	7.4%			
CAGR	6.4%	8.5%	7.5%			
Sharpe	1.04	1.85	1.54			
Standard Deviation	6.1%	4.5%	4.8%			
Ulcer Index	4.8%	1.6%	2.3%			
Max Drawdown	14.0%	6.5%	8.1%			
1981 to 1990						
Annualised Mean	13.0%	14.2%	13.3%	12.2%	15.0%	13.7%
CAGR	13.4%	14.8%	13.8%	10.0%	14.6%	13.2%
Sharpe	1.49	1.71	1.56	0.52	0.94	0.85
Standard Deviation	8.8%	8.3%	8.5%	23.5%	15.9%	16.1%
Ulcer Index	4.6%	2.5%	2.9%	15.9%	8.8%	9.6%
Max Drawdown	10.5%	9.6%	10.1%	34.9%	19.8%	22.6%
1991 to 2000						
Annualised Mean	16.1%	16.9%	16.6%	-1.8%	5.1%	3.6%
CAGR	16.7%	17.9%	17.6%	-3.4%	4.3%	2.7%
Sharpe	1.54	2.16	2.10	-0.10	0.40	0.27
Standard Deviation	10.5%	7.8%	7.9%	18.0%	12.8%	13.2%
Ulcer Index	4.2%	2.3%	2.5%	34.6%	12.3%	17.4%
Max Drawdown	22.3%	8.2%	8.8%	61.5%	23.5%	29.3%
2001 to 2010						
Annualised Mean	11.3%	10.9%	10.3%	11.6%	12.4%	11.9%
CAGR	11.7%	11.2%	10.6%	10.5%	12.1%	11.4%
Sharpe	1.63	1.80	1.66	0.65	0.89	0.84
Standard Deviation	7.0%	6.0%	6.2%	17.7%	14.0%	14.1%
Ulcer Index	2.2%	1.9%	2.1%	19.9%	9.8%	11.0%
Max Drawdown	9.4%	6.7%	7.2%	38.5%	23.8%	24.4%

Figure 5.21 Segmented Returns by Decade for GOVI Strategies

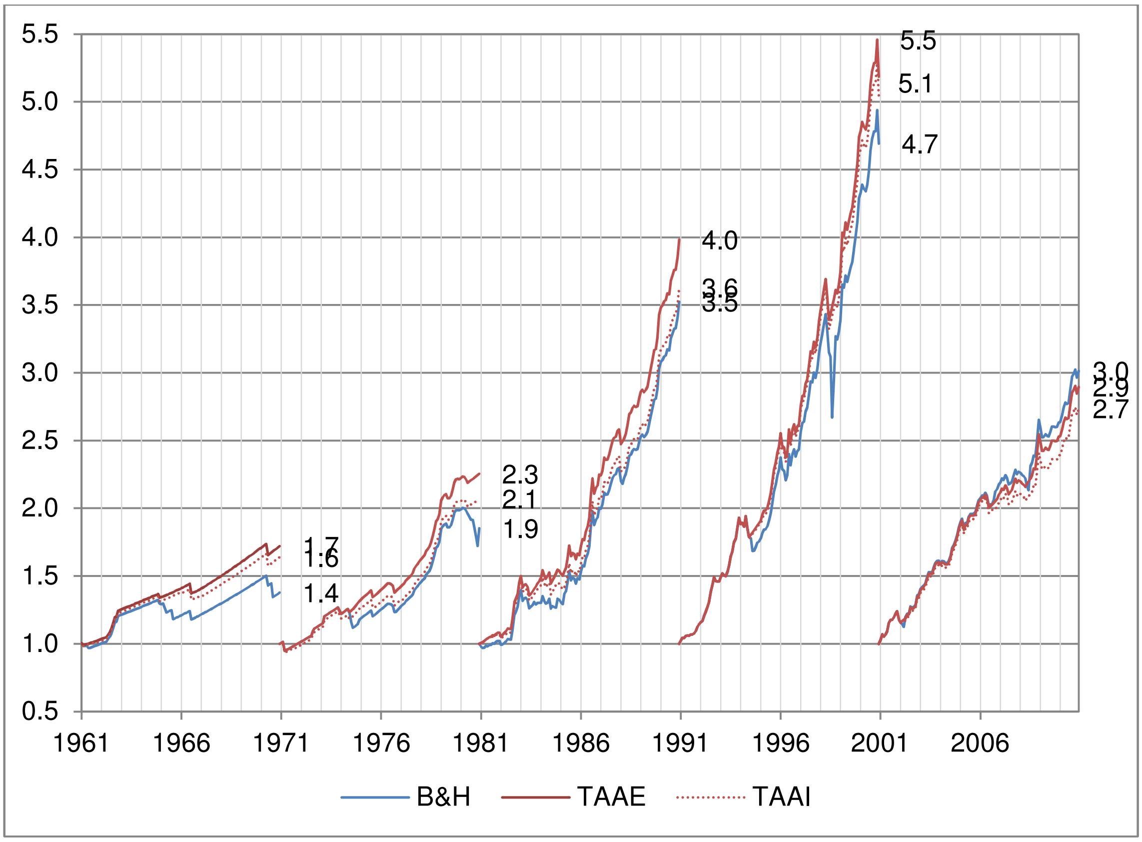
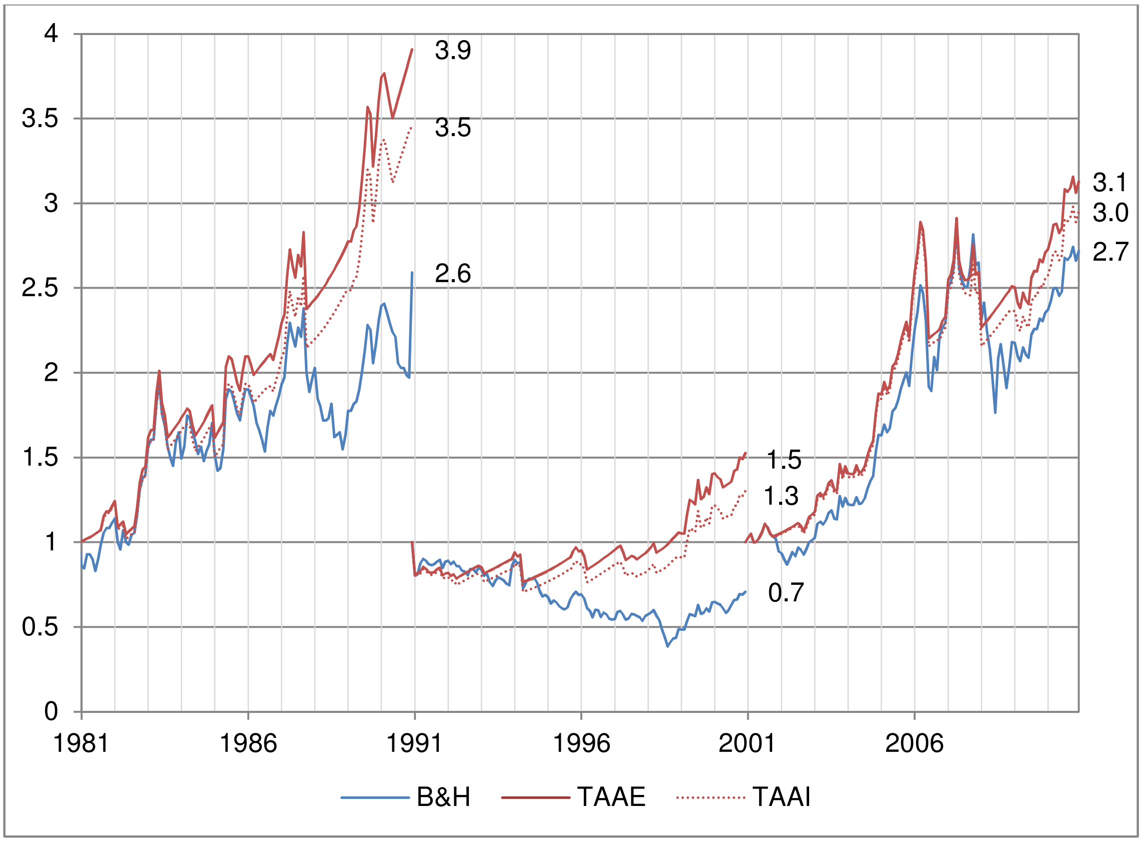


Figure 5.22 Segmented Returns by Decade for PUTI Strategies



5.5 Inferential Statistics

Inferential statistics were used to determine the level of significance of the results. Since both groups emanated from the same population, the groups were dependant. Hence, specific statistical processes had to be used for the dependent populations. Monthly percentage changes across all selected indices for the period between 1961 and 2010 were used to generate results. Results were generated using Microsoft Excel's data analysis tools. In line with the hypothesis of this research two statistical measures were used to analyse returns and volatility of the strategies. The arithmetic mean of the data was used as a measure for returns. The standard deviation was used as a measure of volatility. A statistical analysis of variance was performed. Since standard deviation is the square root of variance, any findings on variance were applicable for standard deviation.

Section 5.5.1 presents the results for the comparison of means. An hypothesis test was performed using the matched paired t-test. The results reveal that the tactical asset allocation strategies across all indices generated no statistically different means from that of the corresponding buy-and-hold strategies.

Section 5.5.2 presents the results for the comparison of variances. An hypothesis test was performed using an Anova F-test. The results reveal that the tactical asset allocation strategies across all indices generated statistically different variances from that of the corresponding buy-and-hold strategies.

All results were generated using a 95% confidence level.

5.5.1 Comparison of Means

An hypothesis test was performed using the matched paired t-test. The test sought to determine if there was any statistical difference between the TAA's and B&H's means. Therefore, an hypothesised mean difference of zero was used. A confidence level of 95% was required. Since the t-test was two tailed a 2.5% level of significance was used. Table 5.14 shows results generated using a t-test comparing TAAE with B&H. The results showed that the t-statistic for all indices fell within the range of their respective positive and negative t-critical values. The P-values generated from the t-test were greater than 0.1. This provides strong evidence that there is no statistical difference between the means of TAAE and B&H.

Table 5.14 t-Test Comparing TAAE with B&H

t-Test: Paired Two Sample for Means	ALSI		RESI		FINI	
	TAAE	B&H	TAAE	B&H	TAAE	B&H
Mean	1.23%	1.21%	1.43%	1.34%	1.30%	1.19%
Variance	0.23%	0.38%	0.40%	0.65%	0.20%	0.33%
Observations	600	600	600	600	600	600
Degrees of Freedom	599	599	599	599	599	599
t-Statistic	0.1231		0.4417		0.7944	
P(T<=t) two-tail	0.9021		0.6589		0.4273	
t-Critical two-tail	2.247		2.247		2.247	
t-Test: Paired Two Sample for Means	AGMI		GOVI		PUTI	
	TAAE	B&H	TAAE	B&H	TAAE	B&H
Mean	1.19%	1.13%	0.92%	0.83%	0.89%	0.67%
Variance	0.50%	0.99%	0.03%	0.05%	0.17%	0.31%
Observations	600	600	600	600	420	420
Degrees of Freedom	599	599	599	599	419	419
t-Statistic	0.2064		1.8168		1.1980	
P(T<=t) two-tail	0.8365		0.0697		0.2316	
t-Critical two-tail	2.247		2.247		2.249	

Table 5.15 shows the results generated using a t-test comparing TAAI with B&H. It should be noted that the t-statistic for both ALSI and AGMI was negative. This was because the mean for their TAAI was less than the mean for their B&H. The results showed that the t-statistic for all indices fell within the range of their respective positive and negative t-critical values. The P-values generated from the t-test were all greater than 0.1. This provides strong evidence that there is no statistical difference between the means of TAAI and those of B&H.

Table 5.15 t-Test Comparing TAAI with B&H

t-Test: Paired Two Sample for Means	**ALSI**		**RESI**		**FINI**	
	TAAI	B&H	TAAI	B&H	TAAI	B&H
Monthly Mean	1.18%	1.21%	1.38%	1.34%	1.25%	1.19%
Variance	0.23%	0.38%	0.40%	0.65%	0.20%	0.33%
Observations	600	600	600	600	600	600
Degrees of Freedom	599	599	599	599	599	599
t-Statistic	-0.1868		0.1938		0.4747	
P(T<=t) two-tail	0.8519		0.8464		0.6352	
t-Critical two-tail	2.247		2.247		2.247	
t-Test: Paired Two Sample for Means	**AGMI**		**GOVI**		**PUTI**	
	TAAI	B&H	TAAI	B&H	TAAI	B&H
Monthly Mean	1.13%	1.13%	0.90%	0.83%	0.83%	0.67%
Variance	0.51%	0.99%	0.03%	0.05%	0.17%	0.31%
Observations	600	600	600	600	420	420
Degrees of Freedom	599	599	599	599	419	419
t-Statistic	-0.0054		1.2432		0.8844	
P(T<=t) two-tail	0.9957		0.2143		0.3770	
t-Critical two-tail	2.247		2.247		2.249	

5.5.2 Comparison of Variances

An hypothesis test was performed using an Anova F-test. The test sought to determine if the variance from a B&H was statistically greater than the variance from a TAA. A confidence level of 95% was required. Since the F-test was one-tailed a 5% level of significance was used. Table 5.16 shows results generated using an F-test, when comparing B&H with TAAE. The results showed that the F-statistic for all indices was greater than their corresponding F-critical values. The P-values generated from the F-test were less than 0.01. This provides overwhelming evidence that the variances for B&H are statistically greater than the variances for TAAE.

Table 5.16 F-Test Comparing B&H with TAAE

F-Test Two-Sample for Variances	**ALSI**		**RESI**		**FINI**	
	B&H	TAAE	B&H	TAAE	B&H	TAAE
Monthly Mean	1.21%	1.23%	1.34%	1.43%	1.19%	1.30%
Variance	0.38%	0.23%	0.65%	0.40%	0.33%	0.20%
Observations	600	600	600	600	600	600
Degrees of Freedom	599	599	599	599	599	599
F-Statistic	1.6435		1.6390		1.6446	
P(F<=f) one-tail	0.0000		0.0000		0.0000	
F-Critical one-tail	1.1104		1.1104		1.1104	
F-Test Two-Sample for Variances	**AGMI**		**GOVI**		**PUTI**	
	B&H	TAAE	B&H	TAAE	B&H	TAAE
Monthly Mean	1.13%	1.19%	0.83%	0.92%	0.67%	0.89%
Variance	0.99%	0.50%	0.05%	0.03%	0.31%	0.17%
Observations	600	600	600	600	420	420
Degrees of Freedom	599	599	599	599	419	419
F-Statistic	1.9731		1.4801		1.8609	
P(F<=f) one-tail	0.0000		0.0000		0.0000	
F-Critical one-tail	1.1104		1.1104		1.1335	

Table 5.17 shows results generated using an F-test, when comparing B&H with TAAI. The results showed that the F-statistic for all indices was greater than their corresponding F-critical values. The P-values generated from the F-test were less than 0.01. This provides overwhelming evidence that the variances for B&H are statistically greater than those for TAAI.

Table 5.17 F-Test Comparing B&H with TAAI

F-Test Two-Sample for Variances	**ALSI**		**RESI**		**FINI**	
	B&H	TAAI	B&H	TAAI	B&H	TAAI
Monthly Mean	1.21%	1.18%	1.34%	1.38%	1.19%	1.25%
Variance	0.38%	0.23%	0.65%	0.40%	0.33%	0.20%
Observations	600	600	600	600	600	600
Degrees of Freedom	599	599	599	599	599	599
F-Statistic	1.6202		1.6218		1.6201	
P(F<=f) one-tail	0.0000		0.0000		0.0000	
F-Critical one-tail	1.1104		1.1104		1.1104	
F-Test Two-Sample for Variances	**AGMI**		**GOVI**		**PUTI**	
	B&H	TAAI	B&H	TAAI	B&H	TAAI
Monthly Mean	1.13%	1.13%	0.83%	0.90%	0.67%	0.83%
Variance	0.99%	0.51%	0.05%	0.03%	0.31%	0.17%
Observations	600	600	600	600	420	420
Degrees of Freedom	599	599	599	599	419	419
F-Statistic	1.9555		1.4445		1.8303	
P(F<=f) one-tail	0.0000		0.0000		0.0000	
F-Critical one-tail	1.1104		1.1104		1.1335	

6 Discussion of Results

The aim of this research is to assess a quantitative approach to tactical asset allocation to reduce volatility and increase the investment returns available from selected Johannesburg Stock Exchange (JSE) indices.

The research first sought to understand how a tactical asset allocation strategy (TAA) would perform when implemented on the All Share Index (ALSI). The period between 1961 and 2010 was analysed. A strategy using a ten-month simple moving average derived from Faber's (2007) work was implemented. However in differentiating itself, results were generated for tactical asset allocation strategies with transaction costs excluded (TAAE) and tactical asset allocation strategies with transaction costs included (TAAI). Other strategies using simple moving averages based on variations in the number of months were also implemented. The strategies were compared in order to establish if the research's primary strategy was the optimal strategy for the period. The strategy was implemented on a small range of other equities and asset classes using specific indices as proxies. The results for the indices were compared and a picture of how TAA performed was presented. The initial period of analysis was over 50 years. All indices were then reinvestigated, examining the strategy's performance over five individual ten-year periods. Lastly the strategies were submitted to statistical rigger, analysing their monthly means and their standard deviations. Inferential statistics were performed in order to establish whether these measurements were statistically different from those of the buy-and-hold strategies (B&H).

In order to gain insight into the results presented in Chapter 5, it is important to understand measures used within this research. The measures have been split into two categories, those of risk and return.

Under the risk category, three measures have been used. First is standard deviation, which represents the volatility of an investment. Volatility is primarily a risk measure. However, as will later be shown it has profound effects on return. Second is the ulcer index, which represents the downside volatility or exposure of an investment (Martin & McCann, 1989). Unlike standard deviation, the ulcer index is a true indicator of risk. The index only considers the negative effects of volatility. A lower value of the ulcer index shows a reduction in drawdown. A lower value of standard deviation could either mean a reduction draw up or drawdown or a combination of the two. Lastly maximum drawdown, highlights the worst continuous loss throughout an investment period.

Under the return category, three measures were used. The first was the annualised monthly mean. This is an average of the monthly percentage changes in return, which was then annualised. A mean is purely a return measurement and does not take into account the volatility of an investment. Second was the compound annual rate of return. At first glance this measurement appears to be the same as the annualised monthly mean. However, its results are somewhat different, due to the effects of compound interest. Hirschey and Nofsinger (2010) define compound annual growth rate as the geometric mean return of an investment; it is the actual return an investor receives. Last is the Sharpe ratio. The correlation between this ratio and the compound annual growth rate can be seen throughout the results of this research. The Sharpe ratio is a ratio between excess returns and standard deviation of a portfolio (Hirschey & Nofsinger, 2010). This ratio gives real insight into how returns are generated. Returns can be improved by either increasing excess returns or by reducing the volatility of an investment. Therefore, while the annualised monthly mean represents return, compound annual growth rate represents risk-adjusted return. This is the true return of an investment.

6.1 Results for All Share Index

The Results for the All Share Index (ALSI) are presented in Figure 5.1 and Table 5.3. At first glance the results for TAAE appear superior across all measures. However the results for TAAI fall short when comparing return measurements. The annualised monthly mean was 1.0% lower than the B&H, while strategies share the same compound rate of return and Sharpe Index. Even though transaction costs eroded gains in return, the reduction in volatility allowed the TAAI and B&H to yield the same risk-adjusted returns. However the graph of the returns for investments strategies using ALSI, suggests the TAA may not have yielded superior returns for the entire investment period.

When comparing these initial results with Faber's (2007) work, the performance of the strategies was comparable. Faber implemented a TAAE on the S&P 500 from 1900 to 2005. He also found marginal differences between the TAAE and B&H on the annualised monthly mean. The difference between TAAE and B&H for the S&P 500 and ALSI was 0.12% and 0.3% respectively. In contrast the compound annual growth rates of the TAAE for both the S&P 500 and ALSI were more substantial. S&P 500 and ALSI investments using TAAE yielded 0.9% and 1.3% difference between their respective B&H's. Similar improvements between indices were made across the volatility and risk measurements. Interestingly, the strategies spent the same percentage of time in each respective market, while the strategy implemented on ALSI made slightly more trades. This may be indicative of the more volatile market conditions within South Africa.

In order to gain a greater understanding of exactly how the TAA performs, two types of graphs are presented. Figure 5.2 showed the frequency distribution of the strategies implemented on the ALSI. As stated the returns appear to be normally distributed. This is important, since statistical measures such as mean and standard deviation are only meaningful for normal distributions. The graph also indicates that TAA was able to reduce negative returns. The graph did not lend any insight into positive returns, except that they appear similar.

Figure 5.3 and Figure 5.4 were able to provide a more detailed picture of the effect TAA has on positive and negative returns for the ALSI. The graphs present a scatterplot of excess returns for both TAAE and TAAI. In a step out of the norm, trend lines are drawn for both positive and negative excess returns. Equations and their R-Squared values are shown on each graph.

In examining the positive excess market returns for TAAE, the gradient of the equation is 0.91. This shows that TAAE produced similar, yet slightly lower, excess returns than B&H (a gradient greater than one, would have indicated that TAA was able to generate yearly returns in excess of B&H). The high R-Squared value shows that there is a strong correlation between the equation and the returns. TAAI produced similar results, but as expected, had a slightly lower value for its gradient at 0.89.

From the results, two things can be deduced with respect to positive excess market returns. First, due to timing issues TAA is not able to capture all positive excess returns within the market. Second, the difference in gradient between the TAAE and TAAI is far less than their values and a gradient of one. This suggests a TAA's timing ability has far greater impact on its positive excess returns than the impact of transaction costs.

In examining the negative excess market returns for TAAE, the gradient of the equation was 0.56. This value is substantially less than one, indicating that TAAE was able to reduce the overall average of negative excess returns. However the R-Squared value was relatively low, implying there is a low correlation between the equation and the returns. This is in line with the scattered distribution of the negative returns. What this means is that although TAA is able to improve the majority of the market's negative excess returns, there are still cases where negative returns have not been improved. In respect of the ALSI, there are instances where negative returns were exacerbated. TAAI had a gradient of 0.61 also with a low R-Squared value. The difference between the gradients of TAAE and TAAI is higher that the difference for the positive excess returns. However, this difference is still significantly less than their gradients and a gradient of one. This again implies that a strategies timing ability is the most important factor in reducing negative returns. However although relatively small, the effects of transaction costs are most prevalent in negative excess market returns.

6.2 Results of Different Tactical Asset Allocation Strategies

A ten-month simple moving average was used as the basis for the rules governing the TAA within this research. The decision to use this strategy was grounded in other research (Faber, 2007; Siegel, 2008). This avoided the possibility of data mining and eliminated the need for out-of-sampling testing. Research has also been performed using different moving averages. Garrison, Sera and Cribbs (2010) tested a TAA using a 12-month simple moving average against B&H for composite equity and bond portfolios within the United States. TAAs using moving averages of 50, 150 or 200 days has been tested in the emerging equity markets of Latin America and Asia (Ratner & Leal, 1999).The above-mentioned research found that TAA yielded superior results over B&H. The existence of other research using different moving averages, suggests that the ten-month simple moving average is not a unique solution.

Strategies using four, six, eight, ten and 12-month simple moving averages were tested on ALSI from 1961 to 2010. Table 5.4 and Table 5.5 present results for TAAE and TAAI using different monthly moving averages. The results in both cases indicate that a six-month moving average would have yielded the optimum strategy for the period. More importantly the results reveal that a TAAI could have produced significantly higher high returns than the B&H.

The results for TAA using the four-month moving average lent some important insights into the performance of TAAI's. The four-month moving average yielded the second highest TAAE compound annual growth rate at 16.1%, marginally less than the optimal strategy at 16.6%. In comparison, the TAAI compound annual growth rate was 13.6%, which is significantly less than the optimum strategy at 15%. The reason for this deterioration in returns can be linked to the number of trades per year. The more reactive a strategy is the greater the number of transactions, which in the long run could erode strategic gains.

Figure 5.5 and Figure 5.6 plot the returns of the different strategies. The graphs illustrate that the TAAEs over the period outperformed B&H. However it is only with the inclusion of transaction costs that some of the strategies fall short.

Faber (2007) also performed similar tests on the S&P 500. His research shows that a six-month moving average yields the best risk and volatility results, while the twelve-month moving average yields the highest returns.

6.3 Results for Equities and Other Asset Classes

Thus far, all discussion has revolved around the results of the TAA being implemented on the All Share Index (ALSI). In order to gain greater understanding on how or whether TAA actually works, the strategy was implemented on a small range of other equities and asset classes using specific indices as proxies.

Two specific equity classes were chosen for the purposes of this research. The equity classes were represented by the Financial & Industrial Index (FINI) and the Resource Index (RESI). The reason for this was that together they represent the majority of companies listed on the JSE, which forms the basis of the ALSI. The research also looks to diversify its findings by analysing different asset classes. Commodities, bonds and real estate were chosen. They are represented by the Africa Gold Mining Iindex (AGMI), the Government Bond

Index (GOVI) and the Property Unit Trust Index (PUTI), respectively. Results for selected indices are presented in both tabular and graphical form.

TAAE displays superior results across all measures for the period. All return, volatility and risk measurements show improvements. The most significant improvements, however, are in the volatility and risk measurements. The relative performance of TAAs return measurements reveals that compound annual growth rates yield the greatest improvements.

TAAIs only showed superior results for volatility and risk measurements. Return measurements generate mixed results. The annualised monthly means either show marginal improvements or reductions across the indices. All compound annual growth rates provide either equal or superior returns.

A comparison of the results for the different equity classes provides valuable insight into the performance of TAA. As mentioned, the stocks contributing to the makeup of the FINI and RESI are the same stocks that make up the ALSI. All three indices yield the same compound annual growth rate for B&H at 13% for the period. However investments in FINI and RESI using TAAE yield 15.5% and 15.9% respectively, while an investment in ALSI using TAAE only yields 14.3%. Similarly, investments in FINI, RESI and ALSI using TAAI yield 14.3%, 14.6% and 13%. This shows that by splitting up the equity classes higher returns are possible using the same TAA.

By implementing TAA on FINI and RESI, improvements in relative performance of all return measures can be seen, in comparison to ALSI. The relative performance for standard deviation remains the same, while the relative performance for the ulcer index is significantly improved. Interestingly, the actual values for the ulcer index across all equity classes using both TAAE and TAAI are comparatively the same. Due to the fact that the B&H for FINI and RESI's ulcer index came from a higher base, there was a relative improvement in performance. The improvement in the ulcer index means that the TAA is able to reduce the downside volatility of the equity classes and hence could improve their returns.

The improvement in TAA returns using FINI and RESI, against the returns for TAA using ALSI, suggests that the strategy reacts better to portfolios of stocks from similar industries. The evidence suggests that it is better to apply a TAA to a diverse set of portfolios containing similar stocks, than trying to apply a TAA to a diversified portfolio. Industries or sectors provided clearer signals than the markets or portfolios that consolidate them.

Results for other asset classes were generated using AGMI, GOVI and PUTI. When compared with ALSI, the relative improvements of the TAA's return measurements were superior. The risk and volatility measurements' relative performances varied. However, they all showed superior relative reductions in their downside volatility measurement, the ulcer index.

6.4 Results for Segmented Comparison of Strategies by Decade

The results for TAA over the 50-year period from 1961 to 2010 showed that TAAE yielded superior returns across all six selected indices. TAAI yielded superior returns for five of the six selected indices, whilst the returns for the ALSI were equal to that of its B&H. All risk and volatility measures were reduced using TAA. However, some of the graphs indicate that the TAA's did not outperform B&H for the entire period. The graphs are able to show exactly when TAA failed and when it was playing catch up. Although TAA returns are expected to be superior to B&H returns over the long run, this should not be expected in the short term. However the definition for long run and short run needs to be congruent with investors' expectations. In line with this thought pattern results have been generated for five separate decade-long investments per index. PUTI was split into three decade-long investments.

The ALSI and FINI are paired together in Table 5.11. Immediately the optimistic picture presented in previous sections dissipates, with the reality of each decade being presented. The two indices share their worst performing decade between 1991 and 2000. TAA's results are dismal for this period as it was unable to mitigate the losses associated with the market crash of 1998. To make matters worse, it was then unable to capture the gains associated with the bounce back in indices. TAA using the ALSI only produced superior returns in two out of five decades. Faber (2007) produced rudimentary results for the South African market using TAAE. His results show that TAAE yielded inferior results to a B&H of the tested period. The period ran from 1972 to 2005. The results within this research agree with his findings.

Although TAA using FINI performed poorly for the period between 1991 and 2000, the strategy performed better in the remaining four decades. TAAE using FINI produced superior returns in the four remaining decades. TAAI returns were marginally worse than B&H in the period from 1981 to 1990, with a compound annual growth rate yielding 15.1%, instead of 15.5%. With the exception of the crash of 1998, TAA using FINI performed well throughout the period.

The RESI and AGMI were paired together in Table 5.12. TAA performed much better on the RESI and AGMI when compared to the ALSI and FINI. The strategies were able to overcome the drawdowns caused by the market crash in 1998. TAA using RESI was in fact able to capitalise on the bounce back after the crash. Investments in the two indices using TAA did not yield superior returns in all decades. For the decade between 1971 and 1980 the strategies were unable to capture all available gains. It should be noted that returns for that decade using the B&H strategy were exceedingly high. “A trend-following model will under-perform on buy-and-hold during a roaring bull market” according to Faber (2007). For the decade 2001 to 2010 returns were also high; TAA produced lower annualised monthly means. However, TAA still managed to yield superior returns as shown by the compound annual growth rate.

Results for GOVI and PUTI are presented in Table 5.13. All TAA volatility and risk measurements yielded superior results across all decades. TAA returns for GOVI marginally underperformed B&H returns in the period between 2001 and 2010. With this exception, all TAA return measurements yielded superior results across all decades.

Figure 5.17 to Figure 5.22 graphically illustrate the performances of TAA for each index, across all the invested decades. By splitting up the investment over separate decades, it can be seen, how TAA actually performed for each index. Of interest is the fact TAAI mirrored the performance of TAAE throughout the different indices and their invested decades. TAAI performance deviated from TAAE in two out of the 28 decades tested. This shows that although TAAI returns were lower than TAAE, the inclusion of cost was not the determining factor for whether the strategy succeeded or not.

6.5 Inferential Statistics

Throughout the discussion the performance of TAA has been evaluated over the period between 1961 and 2010. TAA yielded superior results for all indices for investments made over the entire period. The strategy was then evaluated over individual ten-year periods. The strategy underperformed in some decades using specific indices. The reasons for the strategy's' failure over those decades was discussed. On the whole the strategy performed well. However, the results generated are limited to the period they were generated in. In order to establish whether these results can be inferred, inferential statistics have been performed.

The monthly mean and its standard deviation were analysed. All statistical results were generated to a 95% confidence level. Since the TAA and B&H results were generated from the same population, these results are dependent. This means that specific statistical tests had to be performed.

A comparison of means was performed for monthly means. An hypothesis test was done using the matched paired t-test. The results show that there was no statistical difference between the monthly means of B&H and TAAs for each index.

In order to test standard deviation, variance was used. Standard deviation is the square root of variance. A comparison of variance was performed using the ANOVA F-test. The results showed that TAA's generated variances that are statistically less than the B&H's for all tested indices.

So what does this mean for TAA? TAA is unable to generate absolutes returns that are statistically different from B&H. However, it is able to statistically reduce volatility. This is in line with Siegel's (2008) statement that the major gains for TAA are in reduction in risk. The Sharpe ratio is a measure of return. It is a ration between excess return and volatility. Since there is no statistical difference in TAA means, the only way to increase this ratio is to reduce TAA volatility. Hence, by decreasing its volatility, TAA is able increase its risk-adjusted returns.

6.6 Discussion Summary

Asset allocation is fundamental in determining investment results and is central to any investment process. This point was brought to attention by numerous authors (Hensel *et al*., 1991; Ibbotson & Kaplan, 2000; Xiong *et al*., 2010). Empirical evidence shows that investors get asset allocation wrong more than they get it right (Hirschey & Nofsinger, 2010). The reason for this is routed in human behaviour finance, which was first brought to attention by Kahneman and Tversky (1979). A quantitative approach to tactical asset allocation provides a simple method of tactical asset allocation that is free of human emotion. Faber (2007) performed the initial research within the United States. This research has extended his study to the South African market. The results have shown that tactical asset allocation even including transition costs, can produce statistically significant superior returns across certain asset classes, using a realistic investor timeframe.

7 Conclusion

7.1 Background

The debate around the merits of tactical asset allocation is one that is hotly contested within academic circles. Arguments are offered both for and against the ability of a strategy to successfully time the market. However, the findings within this research provide a valuable contribution to the evidence in favour of market timing. Not only that, but the research revealed new insights into the workings of tactical asset allocation.

The literature shows that asset allocation is fundamental in determining investment results and is central to any investment process (Hensel *et al.*, 1991). It also shows that investors get asset allocation wrong more often than they get it right (Hirschey & Nofsinger, 2010), and provides reasons for this that lie within the realm of behavioural finance (Montier, 2007). A quantitative approach to tactical asset allocation provides an investment method that can mitigate some of the vulnerabilities in the decision making process linked to behavioural finance.

A tactical asset allocation strategy based on a ten-month simple moving average was compared against a buy-and-hold strategy on selected indices within the JSE. The All Share (ALSI), Financial & Industrial (FINI), Resource (RESI), Africa Gold Mining (AGMI), Government Bond (GOVI) and Property Unit Trust (PUTI) indices were examined. The strategies were tested over a 50-year period from 1961 to 2010.

7.2 Findings

The research set out to explore five main questions, and a summary of the answers to those questions is presented below:

1. Tactical asset allocation was able to successfully reduce volatility across all investments.
2. Tactical asset allocation excluding transaction costs was able to generate superior risk-adjusted return.
3. Tactical asset allocation including transaction costs was able to generate superior risk-adjusted return.
4. Tactical asset allocation using ten-month simple moving average was not the optimum strategy for the All Share Index over the specified period. However the ten-month simple moving average was an out-of-sample test and therefore its results holdup to scrutiny.
5. Results across all asset and equity classes were positive. However, the results showed that some indices were better suited for the use of tactical asset allocation.

In examining these questions, key insights into the performance of tactical asset allocation were gleaned.

The research showed that a tactical asset allocation strategy was able to successfully reduce the volatility across all tested indices. These results were achieved by strategies both excluding and including transaction costs. Furthermore the reduction in volatility was shown to be statistically significant in both cases for all indices.

Results of return measurements presented a more complex picture. The annualised monthly means showed mixed returns that were statistically the same whereas the compound annual growth rates yielded superior returns across all indices. The difference in the results of return measurements led to a conundrum. Insights into this conundrum were provided by the Sharpe index, which shows that actual return is a function of absolute return and volatility. Therefore since there was no statistical difference in absolute returns, the strategy was only able to increase its actual/risk-adjusted returns by reducing its volatility. Tactical asset allocation strategies both excluding and including transaction costs showed improved risk-adjusted returns across all indices.

The tactical asset allocation strategy used within this research was based on a ten-month simple moving average. Other periods of moving averages were tested on the ALSI. The six-month simple moving average was found to yield the best returns of the period, with returns exceeding ten-month strategies by an additional 2%. This showed that the ten-month tactical asset allocation strategy was not the optimum strategy for the investment period. Other strategies based on different moving averages could be considered when making actual investments.

A more detailed investigation into the performance of tactical asset allocation strategies was also completed. Investments using each strategy were run over five individual decade long periods for the selected indices. The results showed that the tactical asset allocation strategies underperformed the buy-and-hold strategies in certain decades for different indices. However, some indices performed better than others, lending valuable insight into the performance of tactical asset allocation.

7.3 Limitations of Research

This research is a replication study of Faber's (2007) paper, and is the first such a study to be completed within the South African market. As an extension to Faber's (2007) work, the research included transactions costs applicable to an individual trading on the JSE. However, costs associated with taxation were not included. The research also investigated other periods of simple moving averages as the basis for the tactical asset allocation rule. The six-month simple moving average was shown to be the optimum strategy for the ALSI. However, this result was obtained and tested from within the same sample. Findings within the research show that some asset or equity classes are better suited to tactical asset allocation strategies. These findings were based on a sample of six indices.

7.4 Recommendations for Future Research

A further extension of this work could include the following:

- The inclusion of taxation within the study, and the optimisation of the strategy to handle these costs.
- Perform out-of-sample testing of different markets and asset classes, using different periods of simple moving averages, a link between the types of markets and/or asset classes should be established if possible.
- Investigate other markets, and in particular examine whether results for tactical asset allocation can be further optimised by splitting strategies over individual sectors within the market.

7.5 Conclusion

Three major insights were gained from the results within this research. First, tactical asset allocation produces superior returns by reducing the volatility of the investments, hence increasing its risk-adjusted returns.

Second, a tactical asset allocation strategy under performs a buy-and-hold strategy when market conditions over the investment period are extremely bullish. This sentiment was also confirmed by Faber (2007). However, over a long term investment period, tactical asset allocation provides stable and superior returns.

Last, and perhaps most significantly finding within this research, is that a tactical asset allocation strategy produces its best results when implemented on specific market sectors or asset classes. The evidence suggests that it is better to apply separate strategies to a diverse set of portfolios containing similar stocks, rather than trying to apply a singular strategy to a diversified portfolio.

In summary, evidence has been presented for the South African stock market that shows that tactical asset allocation can provide returns in excess of the market, even in the presence of current transaction costs prices. Tactical asset allocation reduces the volatility and exposure of an investment and in doing so it not only reduces the riskiness of the investment but it increases its returns.

8 References

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9 Appendix 1

Glossary of Abbreviation

Abbreviation	**Description**
B&H	Buy-and-Hold Strategy
TAA	Tactical Asset Allocation Strategy
TAAE	Tactical Asset Allocation Strategy Excluding Transaction Costs
TAAI	Tactical Asset Allocation Strategy Including Transaction Costs
JSE	Johannesburg Stock Exchange
ALSI	All Share Index
FINI	Financial & Industrial Index
RESI	Resource Index
AGMI	Africa Gold Mining Index
GOVI	Government Bond Index
PUTI	Property Unit Trust Index
S&P 500	Standard and Poor's 500 Index